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Practical Teacher

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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

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FOOD—(*Continued*).

KEEPING the foregoing facts in mind, we get a basis for classification. The value of a food depends upon the quantity of those elements which are most easily utilised. Nitrogenous food is distinguished from all others by a portion of the nitrogen passing away in the urine as urea. It is probable that urea is the portion of the albuminous principle which is incapable of utilisation. Its chemical formula is $C_2H_4N_2O_2$. It is easily resolved into carbonate of ammonia and water. When urea is separated from the remaining constituents of albumen, there is a surplus of C and H, which represents the latent force of a given nitrogenised food. It is found by experiment that 100 parts of albumen require 150 parts of oxygen to enable it to be properly oxidised. Dr. Pavy (in his 'Food and Dietetics') gives a useful table as to the comparative value of certain representatives in the group.

Assuming that 100 parts of albumen require 150 of oxygen for perfect oxidation, he shows that grape sugar only requires 106, starch 120; but that fat demands 293. Albumen is therefore about half-way between sugar and fat, and it is in these proportions that each is capable of developing heat when properly digested by the human body. The chief duty of nitrogenous food is to repair tissue. It assists the digestion of hydro-carbons and carbo-hydrates. The labour value of such a food is thought to be by some the amount of nitrogen contained in it. It tends also to produce fierceness and savage habits; a diet limited to hydro-carbons makes people, as well as animals, comparatively mild and tractable. This, as regards the latter, is well exemplified in the case of bears. The vegetable-feeders are easily tamed, but no one can tame the Polar bear, which feeds exclusively on flesh. It is found by experience that animal-feeders among men are best able to do that muscular work which requires the continuous exercise of great strength. The power is, however, intimately associated with the quantity of carbonic acid expelled from the lungs, and not the quantity of urea excreted by the kidneys. But this latter is associated with the quantity of nitrogen in the food. Work can be done for some time without nitrogenous food, but it cannot be done for long if carbon be withheld.

Fats, or Hydro-carbons.—Fats are more powerful heat-producing agents than the carbo-hydrates, such as sugar. An average fat contains: Carbon, 79; hydrogen, 11; oxygen, 10 parts—in 100. The chemical formula has been given as $C_{10}H_{18}O$. The oxygen is not sufficient to satisfy the hydrogen. Ten grains of fat are sufficient when properly burnt to raise 23·32 lbs. of water 1 degree F., which equals 18,003 pounds of water raised one foot high. This brings it into comparison with Joule's foot-pound. Mr. Joule found that the amount of energy under the form of heat which raised water 1 degree when put into the form of force raised 772 lbs. 1 foot high. The dynamic equivalent of a thermal unit is said to be 772 foot-pounds.

It is found by experience that fat food is preferred in cold countries. There are three fat compounds—stearine, margarine, and oleine. Stearine is the most solid fat; it melts at about 145° F.; it is never found in vegetables. Oleine is always fluid at ordinary temperatures, and occurs in both animals and vegetables. Margarine is intermediate between the two, and found in both kingdoms. Fat assists digestion, assimilation, and nutrition, and it also performs some highly-important functions in the production of nerve force, for it exists in large quantity in the nerve tubes as well as in the nerve cells. It also fills up empty spaces, equalises pressure, and gives beauty of form to the body; and being a bad conductor, it enables it to retain animal warmth. It is said by some physiologists that whilst nitrogenous matter assists to make up the body and forms the acting instrument, it is the oxidation of non-nitrogenous matter which supplies the motive power, and that fat is the most sustaining kind of food, though one is scarcely able to live upon it alone for any time.

Starches, Sugars, Carbo-hydrates, etc.—In these compounds the H and O exist in proper proportions to form water, but it is not intended to imply that they are actually combined as water in the substance itself. The group consists of *starch, cane* and *grape sugar, sugar of milk, muscle sugar* (inosite), *amyloid substance, gum, dextrine, cellulose, woody fibre,* etc. Starch is the basis of all farinaceous foods. In the digestive organs it is changed first into dextrine, then

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into grape sugar, whilst cane sugar is itself the product of starch in the plants in which it is found.

Cane sugar is changed into the grape form in the human stomach. The formula for starch is $C_{12}H_{10}O_{10}$, whilst that of cane sugar is $C_{12}H_{11}O_{11}$, and grape sugar $C_{12}H_{12}O_{12}$. It is similar in composition to sugar-of-milk. Amyloid substance is the same, whilst gum = $C_{12}H_{11}O_{11}$. Dextrine is similar to starch, viz., $C_{12}H_{10}O_{10}$, and lignine and cellulose correspond with it. Lignine, though corresponding in chemical composition, is utterly insoluble in the human digestive organs, and cellulose is not much better. It has been already shown that sugar has only one third the value of fat, and is as two to three compared with albumen. It is doubtful whether the carbo-hydrates contribute to force-production by direct oxidation, but they do become changed into fatty or some other matters and are stored up (when not immediately wanted) for use at a future time. They are metamorphosed in the liver, which is the fountain from which fat supplies are drawn to be laid down until wanted for the purpose of the animal economy. Over-feeding tends to produce fatty liver:—a fact which is turned to account in Strasburg in the production of '*foie gras*,' which is simply a disease in the liver of the goose, produced by overfeeding the animal whilst withholding light and exercise. There used to be a great controversy among physiologists as to the possibility of the conversion of the carbo-hydrates into fat, but the inhabitants of Alsace are practically acquainted with the result of feeding geese with maize. It appears, therefore, that by some principle belonging to vitality, which at present is not fully explained, sugar changes from the lowest rank as a heat-producer to that of the highest before it can be utilised in the system.

Acids and Alcohols.—The organic acids, such as malic, citric, and tartaric acids, are found in the juices of vegetables, especially in some kinds of fruits; they are brought out by chemical changes in the starches and cellulose of the plant. Carbonic acid being absorbed, the carbon is assimilated and the oxygen liberated. As the fruit approaches maturity there is alteration of process, and starch changes into sugar, the excessive acid of unripe fruit is altered by oxidation, tannin ($C_{27}H_{22}O_{17}$) is oxidised, and the sweetness of the fruit perfected. Fruits form agreeable and refreshing kinds of food when eaten in moderate quantities. The amount of nitrogenous matter in them is low, and they do not possess much nutritive value. In cold climates they do not rank so high as in the tropical regions, where the necessity for the production of animal heat is lessened. Nature points to this when she produces abundance of fruit in the hot climates, easily sustaining life when assisted by some farinaceous food, whilst in cold regions fat and other animal foods are absolutely required; they are always present in the arctic regions, whilst the luscious fruits of the tropics are not to be found. Nitrogenous food, especially in hot climates, leads to excessive acidity of the urine, whilst fruit decreases it. The vegetable salts which fruit contain become decomposed in the system; they change into carbonates of the alkalis, and are passed away by the kidneys.

There is another tendency on the part of sugar which has had immense influence upon the human race. Sugar ($C_{12}H_{11}O_{11}$) is acted upon by various minute organisms which exist everywhere in nature. One is well known by the name of yeast (*Torula cerevisiæ*), which increases and multiplies at the expense of oxygen in the sugar, no matter whence its source. The nutrition of the fungi, to which class these organisms belong, differs from all other plants, in depending exclusively for growth upon the absorption and decomposition of organic substances with the evolution of carbonic acid. The presence of nitrogen is necessary, by which the growth of the plant is promoted, the sugar is broken up into *alcohol* C_2H_6O and CO_2. Chemically, alcohol stands between a carbo-hydrate and a fat. Liebig thought it useful as a respiratory material, and that it was a food; but more recent investigators have shown that it cannot rank in that category, although there may be circumstances under which it possibly may be oxidised and turned to account. Dr. Parke's experiments, which are too elaborate to be reproduced here, are nearly conclusive on this point, and show that its dietetic value is very limited, even if it has any existence; one thing is certain that—whilst exercise increases circulation, and the expulsion of carbonic acid from the system, and thus promotes warmth, the removal of *débris*, and the increase of appetite—alcohol also increases the circulation, but it decreases the expulsion of carbonic acid and other *débris*, leading to a lessened temperature and decreased appetite, because oxidation is diminished. The chemical alliance of alcohol with carbo-hydrates and fats seems to indicate that it must, like those articles, rank as a food: but chemistry is not a guide in this matter, for lignine or woody fibre is $C_{12}H_{10}O_{10}$, and the turpentines, tar products, coal oils, and camphors, are close to alcohol in chemical composition. We should be poorly off indeed if we had to trust to saw-dust for food. Alcohol, like arsenic, no doubt is useful as a medicine, but as a food it is useless. As a temporary help to relieve an oppressed heart, it may give time for rest to an over-worked organ by reducing the power of the capillaries, leading to engorgement of the periphery of the system, which is its toxic effect. Yet if this process be continued day by day it must cause a diminution of elasticity, and lead to an ultimate breakdown of the constitution. Alcohol should be discarded from the diet table and relegated to its proper place in the pharmacopœia of the physician and the store of the druggist. The effect of the organisms (to which allusion has been made) upon sugar, if continued, leads to the production of lactic ($C_3H_6O_3$) and acetic acids ($C_2H_4O_2$). These acids, with butyric ($C_4H_8O_2$), and a host of others, are considered by chemists as basic acids, obtained by further oxidisation of the primary alcohols, of which ordinary alcohol is but one of a series, and it is usually considered to be the oxide of its basic ethyl. Most of these alcohols are deadly poisons, and their acids are not capable of ranking as foods.

DIET TABLES.

We are now in a condition to consider what is economical and what is wasteful in a food, and to calculate the requirements of a diet table. These will vary according as to whether the table is calculated for men or women, for children or the aged, for the sick, or those who are employed in excessive work or slight manual labour. Health cannot be maintained upon a single article, but is best secured by a good combination of the proximate elements. We have a

guide in milk, which is an all-sufficient food for the young and very aged, but it is not calculated as sufficient for the waste which hard work produces. The average daily diet for men at rest has been made out by observation by many physiologists. Dr. De Chaumont gives the following figures as indicating the necessary amounts of each of the divisions.

	At Rest.	At Ordinary Work.	At Laborious Work.
Albuminates ...	2·5 ozs.	4·31 ozs.	6·5 ozs.
Fats	1·0 ,,	3·53 ,,	4·0 ,,
Carbo-hydrates	12·0 ,,	11·11 ,,	17·1 ,,
Salts	·5 ,,	1·70 ,,	1·4 ,,
	16·0 ,,	20·65 ,,	29·0 ,,

From this table will be seen that labour increases the demand for fat and the albuminates or nitrogenised elements in a much greater ratio, than that of the carbo-hydrates.

In forming a diet table, we must know the mean composition of the articles which it is proposed to use as foods; the quantity of water which is requisite for the continuance of health will be considered in its own section, and the preceding table is calculated as the necessary weight of food which is practically water free; it must be taken as containing its equal weight of water, which can scarcely be removed from it except by destruction of its substance. The quantity of food which a man requires is also to some extent regulated by his own size; a man weighing eight stone does not want as much food as one double that weight. It has been calculated that the necessary food, reckoned according to the above table, should be about $\frac{1}{100}$th part of the weight of the body for each twenty-four hours; to this must be added the sixty or eighty ounces of water which are taken daily in some form of liquid, varying of course according to size, activity, and habits of the individual, the character of the climate in which he lives, and the clothing with which he is covered. It is necessary to know the quantity of each article in the table in a given food before we can assess its value; such tables are published in various manuals: the best of the kind is to be found in Dr. Parke's 'Practical Hygiene,' edited by Dr. De Chaumont, and which gives minute directions upon all the requisite points. In a general way it may be assumed that a healthy and vigorous man will make away with upwards of two pounds of solid (dry) food per day, and that a pound and a half of bread alone will be a starvation diet leading to loss of weight as well as loss of power. Dr. E. Smith has shown us that the average diet of farm labourers in England equal 4·25 ounces of dry nitrogenous matter with 29·5 ounces of starchy matter: whilst he found that the proportion of carbon exhaled as CO_2 from the lungs ranged from six ounces at rest to thirteen ounces when occupied with laborious work. From some other experiments which have been made, it appears that the relations of nitrogenous to carbonaceous or starchy food should be as 1 to $5\frac{1}{2}$ or 6.

The dietaries of women should be about $\frac{1}{10}$th less than that of men, or even $\frac{1}{8}$th less if the former are engaged indoors and the latter out. As regards children, the dietaries of infants should consist of milk up to ten months. Women's milk is richer in sugar than cow's milk, but it is less rich in caseine. Asses' milk is nearer in quality. Up to six or seven months, no other food ought to be substituted, as infants have not the power to digest farinaceous or fibrinous substances, but after six or seven months they may be gradually introduced, though meat should not be given in the solid state until two and a half or three years of age: according to weight, a child requires per pound three times as much starchy food, and six times as much nitrogenous as an adult. At the tenth year, a child requires half as much food as a woman; and at fourteen, quite as much; whilst growing lads of sixteen will want quite as much as an active man.

The skill of the physiologist comes to the front in so associating different articles of diet that all the wants of the system shall be provided for.

It is found by both experience and scientific experiment that nine parts of fat, twenty-two of flesh-forming substances, and sixty of starch and sugar are good average proportions for an average man.

It may be fairly assumed that many more people die in this country of repletion than of starvation.

(*To be continued.*)

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Friedrich Fröbel.

BY HIS PUPIL, HEINRICH HOFFMAN.

X.

MOST happy indeed has that union proved to be. The lasting gratitude and deep veneration of posterity are due to this noble-minded and extraordinary woman. Amidst sorrows and trials untold, amidst the wants and discomforts of an all but primitive state of existence—discomforts which, after a life of luxury, would have been unbearable to an inferior mind—she, like her husband, raised her eye above the thorny path up to the brilliant sun that illuminated and cheered their souls. She was as devoted an enthusiast to the educational views and plans of her husband as he himself was; and the gradual unfolding of the bud to its full splendour and beauty is in no slight degree due to her gentle influence.

The long-deferred task of building, so imperative in its necessity, could now be resumed. Fickle Dame Fortune, who had been frowning on our hero from his very cradle, seemed to give up the hopeless combat with his indomitable spirit, and with the entrance of Frau Wilhelmine, she smiled on the young institution with unwonted amiability. The fame of Keilhau spread farther and farther, and it was but a natural consequence that the number of pupils steadily increased. Fröbel felt deeply that a special evidence of gratitude, something more than sentiment and words, was due to Providence, and a favourable opportunity soon presented itself. In October, all the Protestants of Germany were in grand festive array to celebrate the Tercentenary of the Reformation. Grand speeches and gaudy processions, unveiling of statues, banquetings, and popular rejoicings of all kinds everywhere prevailed.

Fröbel could not content himself with mere vociferations; he searched for some descendants of the great Reformer, and received into his new institution two boys, whom he found at Möhra, near Salzungen, tending their father's cattle. One of them became

afterwards minister at Niederreichstedt, near Freiburg, in the province of Saxony. Thus he erected a living monument to the memory of a great and good man, and evinced his gratitude to the Almighty for the invaluable treasure given to him.

It seemed, however, as if struggles and difficulties were to be the indispensable conditions of Fröbel's very existence. Building was then, as it is now, and probably has ever been since man aimed at more than could be done with his own hands, a costly luxury, and is sure to exceed precalculated estimates. The growing number of boarders necessitated increased accommodation, and disappointment as to monetary income, not a rare phenomenon in educational establishments generally, was not unknown at Keilhau.

To aid the struggling community, Christian Fröbel gave up his prosperous business at Osterode, and, with his whole family, joined the brave pioneers of spiritual liberty. An invaluable acquisition he proved to be. Welcome as was the pecuniary aid he brought, it was of far greater importance that the institution secured in him a manager, who was a practical, clear-headed man of business. This was precisely the thing most needed, for Fröbel himself, as may easily be conceived, was sadly deficient in this respect. Until his death, in 1851, Christian remained a most faithful servant to the grand ideas that originated with his beloved brother. Dr. Wichard Lange, of Hamburg, who knew him personally, says that he was 'a representative of plain, simple-minded human greatness, a hero in his devotion to the educational idea, which he fully recognised in its truth and necessity—a Cato in character.' The necessary improvements were, in his hands, ably carried out, and the young institution prospered beyond all expectation.

During the years 1821-1825, the number of pupils increased to about sixty; new buildings had to be erected, and the inner life of the institution became stronger and healthier from day to day. Under these auspicious circumstances it was but natural that Middendorf and Langethal should find it expedient to follow the example of their leader. They certainly had not to look far for that happiness, which a well-suited marriage is able to bestow. Frau Wilhelmine Fröbel had brought with her an adopted daughter, Ernestine Crispin, who won the heart of Langethal, whilst Middendorf espoused the eldest of Christian Fröbel's daughters. Ascension Day, 1826, was a time of great rejoicing and thanksgiving at Keilhau, for on that day the two nuptials were celebrated; and henceforth the three families became as one, and called themselves the United Educational Family.

It is said that a young oak, to be firmly rooted in the ground, requires a good deal of rough shaking by violent storms. The Keilhau Institution has, to this day, proved to be a powerful oak-tree, and not a little of its strength may perhaps be due to those very storms which now and then threatened to uproot it altogether. The period following the glorious resurrection of Germany, and more especially the ill-famed Carlsbad Congress (1819), were years of political misrule, that belong to the darkest and saddest pages of German history. A panic had seized the thirty-six provinces and petty princelets; a horrid phantom troubled their slumbers. To their dismay, they had just seen in the late war what a terrible strength there was in a united nation. They felt that there were far too many of them to make a firm union, and any common effort in the true interests of the people seemed all but an impossibility. Moreover, their conscience told them that they had shamefully broken faith with their subjects, had disappointed their great expectations, and wilfully flung to the winds the solemn promises which they had made in the hour of need. What, if there lurked somewhere in the minds of the more enlightened the alarming idea, that a strong Government under *one* head—that even the republican form of government—might be possible, nay, even desirable? Such a thing could never be tolerated; so, acting upon the remorseless advice of a Metternich and others, they instituted a most barbarous persecution of all who could be in the least suspected of such dangerous aspirations. Misery untold was spread among many thousands of honourable families, in all parts of Germany. The history of those days is indeed replete with deplorable evidences of the fearful crimes to which human shortsightedness may lead when egotism is at the helm!

Mean sycophants pointed even to Keilhau, as the hotbed of revolution, and the Prussian Government demanded the immediate closing of that harmless institution. Prince Günther, of Schwarzburg-Rudolstadt—all honour to his memory—refused to be dictated to by Prussia, and to condemn without proper inquiry. So he sent his 'superintendent,' Dr. Zeh, a clergyman, to thoroughly investigate the spirit and the tendencies of Fröbel's school. His report is too interesting to be withheld. It was, in effect, as follows:—

'The two days which I spent at Keilhau were to me highly pleasant, interesting, and instructive. They have for ever imbued me with a high esteem of the school, and more especially of its head-master—a man who, amidst storms and difficulties of all kinds, has held and supported it with rare perseverance, and with the purest and most disinterested energy.

'It is delightful to be hailed by a spirit so fresh, so healthy, so free, and yet so strictly regulated by order, such as reigns in this Institution, not only during the school lessons, but also in the playground.

'What, in reality, social life never or rarely exemplifies, may be found here; a family of about sixty members, all firmly united in one strong bond of mutual affection and esteem, all of whom perform, evidently with pleasure, their several duties—a family that cannot but be successful in whatever they do, because of the strong bond of mutual confidence that unites them, and because each of them works for the welfare of the whole.

'With touching veneration and heartfelt affection they all cling to their chief, and whilst the little ones of five years embrace his knees, his friends and assistants listen to his counsels with that confidence which is due to his intellect and experience, and unwearied solicitude for the whole, whilst he himself has linked his whole being with brotherly affection to his fellow-workers.

'It is evident that such a close union, nay, brotherhood, between the teachers must exercise the most beneficial influence on their work. The affection and esteem with which all the teachers cling to their head-master manifests itself in an attention and obedience, which renders disciplinary rigour all but unnecessary. During the two days I heard no rebuking word, neither in the merry gambols in the playground, nor during the lessons; and in the frolicsome bustle, with which after

schoolwork is over, all rush into the open air, gambolling about to their hearts' delight, I saw no real misbehaviour, no rude, unmannered conduct, least of all anything improper.'

(*To be continued.*)

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Lessons in English.

BY ALEXANDER BAIN, LL.D.,

Author of "Education as a Science."

IV.—The Definition of Poetry.

The distinctive characteristic of poetry, as setting forth Ideals, has been assumed, and partly illustrated, throughout the foregoing remarks, but yet deserves a more special handling with a view to the definition that we are in quest of.

Ideality is contrasted with Reality, that is, with facts as they actually occur. To idealize is to depart from the actual, so as to present a picture more acceptable to our feelings. The painter chooses a scene of nature, containing many beauties, but also some things that mar the effect; these last he omits from the picture. The most heroic man has points that either clash with his heroism, or are simply unrelated to it; a poetical narrator avoids all such.

Nothing could better confirm our general position, that the end of poetry is to please, than this habit of altering reality to conform to an ideal. If the poet's so-called "truth" were matter-of-fact truth, he would not dare to idealise, any more than a scientific geographer could venture on re-casting the plan of the Alps, to make them still more impressive and grand, or than an anatomist could teach the contour of the human body from a Greek statue.

As the highest pleasure attainable through works of Fine Art could not be reaped from literal reproduction of the outer world, the Artist is justified by the end in the choice of his means. It is almost certain that a prosaic narrative of the Trojan war would have been very flat in comparison with the Homeric story. We are better pleased with the gorgeous ideal than we should have been with the actual. Possibly there might have been a considerable degree of human interest in the literal facts, but these would not have been a poem; the poetical handling saves all the interest, purges it of its dross, if any, and augments it, in a way that only high poetic genius can accomplish.

In gratifying the powerful feelings of the mind, by setting forth their objects in idea, which is all a poet can do,—much is obtained by proper selection and omission; much by illustration, adornment, and happy turns of thought; much also by *exaggeration*. It concerns the critical art to assign the due limits of this exaggeration, under all variety of circumstances. In some cases, it is not productive of the slightest harm; if only it succeeds poetically, we can easily overlook the departures from literal truth. In the tales of Fairy Land, and the extravagant fictions of middle age Romance, nobody is deceived; we treat them as efforts of imagination, and judge them accordingly. When, however, the subjects of Poetry are historical, we demur to an excessive falsification of the facts. The demand for truth is still greater, when the subject, historical or not, is meant to embody a practical lesson, whether of morality or of prudential virtue. That high ideals of duty should be presented, we allow and commend; mankind never err on that side. The mischief of exaggeration is chiefly seen in over-stimulating our expectations, and in the indulgence of our amiable weaknesses. The best illustration is furnished by the treatment of the love passion.

It may be said that every poet has sung of love. Here is a source of natural interest to start from: the subject is peculiarly fitted for the arts of the singer; and is in itself an inspiration. But do poets abide by a truthful handling? do they keep within the bounds of sobriety in stating the power and fruition of love? Not always.

Poetry does a great work in evoking the charm of the human affections, and thus extending the sphere of their interest in human life. The temptation is to make up for the want of the real by over-doing the ideal pictures. Thus, to present love in all its force, the disenchanting accessories are left out, or toned down; exceptional states of elation are made the rule; the temporary is given as the permanent. In real life, great pleasures are attended with cost, and often interfere with duty; the poet disregards both circumstances. In nuptial love, there is great scope for poetical adornment; and ample justice has been done to the ideal. Whoever wishes a statement of the reality has to refer to sober observation or matter-of-fact biographies. If there be any subject that can dispense with exaggeration, it is love; the literality fairly handled is a sufficient basis of the highest artistic interest.

There being both a spiritual side in the love passion, and a gross or carnal side, poetry can throw its force into either. Dryden is blamed by Wordsworth for knowing only the second. Shakespeare gives us both. There is always a danger in spiritualizing beyond what human nature can receive, as in the saintly pictures of women, so familiar to us.

Yet poetry is a great refining influence in one most important way. Those feelings that, in their own nature, are violent and transitory, are filled out and mingled in the poetic treatment, so as to cover a large space in our minds, and so to multiply the amount of gratification. The wrath of Achilles in its literal circumstances would yield only a few passing throbs of sympathetic resentment. The Homeric treatment is a fifty-fold enlargement of the interest. The melancholy and beautiful story of Hero and Leander, in a matter-of-fact treatment, would have an undoubted interest; every one feels how much this is increased by the poetical expansion.

Other illustrations could be given of the weak points and dangers of idealising. Frequently too much is attempted—the mind failing to rise to the height of the poet's fancy: as when affection becomes maudlin; strength, turgidity; indignation, coarse ferocity.

All this, however, is to sin against the laws of poetry itself.

In Poetry and in Painting, we have what is termed the Realistic school, in opposition to the Idealism that transcends actual life; as in the contrast of the Italian and the Dutch masters in painting. A realistic treatment is not withdrawn from the principles of Art elevation: it merely makes the most of a subject with the least possible deviation from literality. A different kind of pleasure is given by this mode of treatment; and the artist has to study the laws of that pleasure, no less than the ideal composer in his own sphere.

It is by pourtraying character that the poet draws out the feelings that connect us with our kind; and the idealising process involves all the arts of omission, selection, addition, that have already more than once been noticed. A certain amount of these transfiguring operations may be essential to the charm of the picture. The laws of poetic taste, supplementing the instinctive judgment of the poet, determine how far it is safe to go.

The poet has always been permitted to flatter his own nation, and race, and all its notabilities, in the grossest way. Pindar's genius shone in this department; it was a part of his vocation. In every age the same thing is repeated. The devices of omission, selection, and disposition of circumstances, together with poetic ornament, are employed to make the most flattering ideals of national heroes and personal favourites, with the correlative depreciation of enemies.

It is considered eminently poetical to set forth the pomp and circumstance of glorious war, and to shut out of the view the hideous reality. Luckily for mankind, there is a growing revulsion to such an employment of the genius of style.

The Psalm of Life, by Longfellow, is a fine example of the moral ideal, intended not merely, nor principally, to indicate the path of duty, but to encourage, stimulate, and support us in the actual performance. This is a genuine poetical attempt, carried out by poetical means. If it is not often efficacious, the fault is less with the poet, than with human stubbornness. No doubt, he overstates his case; the struggle to do well is more arduous than he allows; but the amount of license taken has been permitted to poets and preachers in every age.

Poetic truth is a misnomer; it is a play upon words. Truth is truth only while representing the world precisely as it is, and by the help of the technical devices of science. An artist's truth is another name for taste, or propriety; in other words, attending to the arts that bring about the poetic charm.

The Ideal justifies itself most in the spheres of the supersensual and the unreal. When we have no actualities to encounter, but only ideals, the shaping of those ideals is everything. It is little use idealising upon everyday facts; thinking of a feast, when we have no food. But when sorrows are imaginary, as in the forebodings of uncertain futurity, they may yield to the power of a poet's solacement.

The Idealising process is demanded for the paramount condition of HARMONY, so essential to Art.

It is by harmonising all the circumstances of a theme, whether narrative, descriptive, moralising, or life-guiding, that we produce an artistic work. In the literality, many things jar with each other, and with the general effect; the artist must efface all discords. In real life, an aristocrat may occasionally fall below the proprieties of his type; a plebeian may rise above it; the poet and romancist would set both right. It is a kind of paradox to learn that very successful pourtrayers of class-types have had little personal contact with examples of them. George Eliot gives a public-house colloquy, true to the life, as we fancy, without having any personal experience of such scenes. Perhaps a literal report of what was said on an actual occasion would seem less truthful than her version. Knowing the characters in general life, she divined what would be most suitable to each, although not exactly corresponding to any single occurrence.

The necessities of Harmony do not imply any great amount of distortion of fact, being fulfilled by the most realistic of poets and artists. To idealise for this end is not merely commendable, it is essential to Art. A painter must group his colours, according to the laws of his art. A poet must see that his language is melodious in itself, and, in keeping with his thoughts. He may idealise much or little, but if he fails to harmonise, neither the interest of his story, nor any amount of life-criticism will make him a poet. It is a main part of minute analysis, as abundantly shown in the foregoing Lessons, to inquire into the keeping of images with the subject and with each other. In such subtle harmonies most frequently consists the poetic thrill.

It has now to be seen how far VERSE makes part of the definition of poetry. In the most characteristic form of poetical composition, verse is employed. It is an aid to the charm of poetry, and in various ways. There is a felt consistency between the march of metre and the tone of mind described as elevation or loftiness of strain. When we rise out of our calm and commonplace moods into a high pitch of emotional excitement, our carriage and mode of expressing ourselves are found to be quite different; and, to that difference, the language of metre is somehow more suitable than the language of prose. As the words that we make use of, by preference, are distinguished by strength, intensity, emphasis, so the form or rhythm is peculiar; and though we cannot declaim in verse offhand, we feel that verse is the form most appropriate to the situation. In the presence of a sublime scene of nature, if we express our feelings in words, they must be words of a high order of majesty and dignity; and, if we were able on the spot, we should impart to them a measured rhythm or metre, as most accordant with the feeling that possesses us.

Such is a statement of the fact, without attempting to assign any reasons arising out of general laws of the mind. That, when our mood is changed from a calm, ordinary pitch, to one of high or intense emotion, the manner of expressing ourselves should also change is what might be expected. Also that, on such occasions, we should choose the words that have been always in use for venting high emotions, is also quite natural. But we are without a reason for the choice of metre, except in the fact that metre has, by long usage, become also associated with a lofty emotional strain. There, however, remains the question, why metre should have been originally chosen for such occasions, and why it should be retained as intrinsically suitable to poetical feeling. True, something different from common prose is needed; nevertheless the selection of an entirely distinct vocabulary might be accepted as a sufficient change.

There are two circumstances that may be assigned as rendering metre more suitable than prose for the excitement of intense emotion. The first is that, being simpler, we fall into it more easily; we know more exactly how to graduate and adapt our emphasis in pronouncing verse, than in the uncertain accentuation of prose.

Now, it is the nature of excitement to lower our intellectual quality of discriminative selection and adaptation of our movements. In passion, we are more

energetic, but less capable of delicately adjusting our movements; hence a simple rhythm suits us better than one which is complex: the simplest measures of all, the Lyric, are connected with the greatest intensity of passion. According as we can approach a subject with more calmness, we can accommodate ourselves to greater elevation of metre, as in the reflective sonnet.

A second way that metre acts, is in controlling or regulating our passionate excitement. When we are very much roused, our movements are violent, irregular and transitory; by falling into a set march, the excitement is subdued and prolonged. Metre is like the regularity of the dance, which gives vent to the stimulus of music and society in a measured style; it is an agreeable and yet effective controlling power.

To these considerations may be added the influence on the mind of regular and recurring beats, which yield a pleasure of very extensive prevalence in the Fine Arts.

Finally, we must revert to the remark already made, that the form of verse has become indelibly associated with the diction and the elevation of poetry. So much is this the case, that, whenever we set ourselves to compose in verse, the language that comes to our mind is the language of poetry. Our recollection of words falls into totally different channels from the recollection of prose diction. Many a one can write better in poetry than in prose; their best thoughts and expressions having come to them by reading the poets. This is quite irrespective of an original predisposition to the form of verse, as seen, for example, in Pope.

Verse is not poetry without the accompaniments of a poetic vocabulary, and all the figures and arts that are accounted poetic; such as inversion, ellipsis, exclamation, and other well-known departures from prose. The putting into verse of the ordinary prose style is not poetry. It is often done in comic writing, as in Hudibras; the comic effect is obtained by the degradation of the lofty form of poetry to a vulgar use: being an indirect testimony to the intrinsic dignity of the metrical form. We have frequent instances of blank verse unintentionally becoming prosaic. This is seen, for example, in Shakespeare, who uses blank verse with unexceptionable propriety, when his subject is familiar and prosaic; in that case, however, he departs from the diction and devices of typical poetry.

Our English Literature has given birth to a species of elevated prose, which is illustrative, both by agreement and by contrast, of the connection of verse with poetry. The grand prose style of Jeremy Taylor, of Milton, and of many more recent writers, as De Quincey, or Carlyle, approaches to poetry in the elevated diction, and in some of the poetical figures, as inversion, exclamation, interrogation: but in stopping short of the form of verse, it also omits the bolder devices of poetry; such as the license in the choice of words, the sustained inversions, the free use of ellipsis, the flights of imagination, the play of fancy, the asserting of unqualified and extravagant propositions,—all which are permitted to the poet only in his full metrical garb. The pomp of language is less sustained, even in the loftiest prose, than in typical poetry. Milton alternates his grandest passages, in the prose works, with purely prosaic touches that would not be admissible in a poem.

Dignity, elevation, lofty emotion, have many degrees. As we rise ever so little above familiarity and common-place, our attitude and movements change, and with them the choice and rhythm of our speech. A speaker at a public meeting, a judge on the bench—unless when purposely humorous—assume at once an altered tone of gesture and of speech. There is a like transition from the attitude of imparting knowledge to the utterance of high emotions, as admiration, veneration, indignation; and at the greatest attainable heights in such outbursts, the form of verse, with the becoming adjuncts, will always be found suitable. The Psalms of David were first translated into prose, but did not fully satisfy the feelings of the pious worshipper until re-clothed in verse.

To illustrate the distinction by example, take first the genuinely poetical stanza of Campbell:—

> Of Nelson and the North
> Sing the glorious day's renown,
> When to battle fierce came forth
> All the might of Denmark's crown.

The metre is here simple and energetic: the diction lofty, the arrangement inverted and rhetorical: the poetic type is fully realised.

As a contrasting example of elevated prose, let us cite the following passage from De Quincey:—

> "The silence was more profound than that of midnight; and to me the silence of a summer morning is more touching than all other silence, because, the lights being broad and strong as that of noonday at other seasons of the year, it seems to differ from perfect day chiefly because man is not yet abroad; and thus, the peace of nature, and of the innocent creatures of God, seems to be secure and deep, only so long as the presence of man, and his unquiet spirit, are not there to trouble its sanctity."

There is here an approximation to poetry, yet with obvious differences. The mind feels much calmer in the perusal, and all the arts of high composition are at a much lower pitch, while yet considerably above ordinary or typical prose.

Quite distinct from the question of verse as more or less essential to poetry, is the consideration of the *language-music*. Melody may accompany verse, or it may not: it may also be realised in prose. In both cases, it is an additional merit; and especially so in poetry. But great poets are not uniformly distinguished for melody; and versification may be very perfect without it. The poet being, above all other men, required to give immediate pleasure, he must not neglect the point of being melodious: but some of the greatest poets have been too devoid of a musical ear to infuse the quality into their verse; witness Popé, Johnson, Scott, as contrasted with Milton, Gray, Coleridge, Moore, Tennyson.

There remains now only the position of the Prose Romance or Novel. Is this poetry or not? As a question of definition, it resembles cases sometimes arising in Natural History, where a species has a large majority of the characteristics of a peculiar genus, with the absence of several that are of leading importance; there being, at the same time, no other genus where the species would be more suitably mated.

Now, the prose romance has the most prominent characteristics of the Epic in verse. It is an idealised narrative, intended to touch the same emotions, and by similar arts. It marches at a lower level of intensity, and accommodates itself to our most ordinary moods, in point of emotional strain; thus endeavouring to give as much as possible of the same kind of

pleasure with less exhaustion in the end. A novel can be read in two or three sittings: an Iliad or a Paradise Lost would be too fatiguing to be so disposed of. The novel is easy, diluted, and familiar prose; but not, therefore, commonplace. Originality and strokes of genius can be made at the lower strains of feeling, as well as in the higher. The attitude is changed, but not the opportunities of being felicitous.

If we do not stretch the definition of poetry so as to include the prose romance, that peculiar form of composition is without a place in any known classification of literature. It is neither science nor oratory; it is not history in the proper sense of the word; it is not morality or theology. If we were to make it a class by itself, we should be repeating nearly all the arts of Poetry, in unfolding its characteristic aims and devices. We have only to allow for the differences due to the form of prose, and for the reasons of adopting the prose vehicle, and there remains to us the substance of poetry. The novel gives us often highly-impassioned prose, thus coming so much nearer to the typical poem, but still divided from that by the distinction between the loftiest prose and the march of verse poetically framed.

Thus, while not obliterating or explaining away the difference that verse makes in composition, we must consider the modern prose romance as a species under the genus Poetry, which must be so far widened as to include it. The form of verse is not to be held as generic and essential to all poetry, but as an important specifying mark in the widest, and perhaps highest class of poetical compositions.

In an exhaustive discussion of poetry, the various recognised species—Epic, Dramatic, Lyric, etc.—would be examined and characterised. This is not indispensable to the definition of poetry as a whole; although it would supply many good illustrations of that definition. In all these leading divisions there are cross-divisions, as, for example, the serious, and the comic, or satiric; and something could still be added by way of reconciling this last class with the definition of versified poetry. Indignant denunciation or grave satire may be quite consistent with the march of metre; but comedy would seem to be such a relaxation of the dignity of the high poetic strain, as to be destructive of the very notion that we have been trying to connect with adequately supported verse. The solution has been already hinted at, and need not be further pursued.

With the assistance of the Lessons on the Emotional Qualities of Style, the characteristics of poetry, as now expounded, will, it is hoped, be sufficiently intelligible. Nevertheless, the length of the discussion, and the numerous windings that it has taken, with occasional repetitions of the same topic from different points of view, seem to justify one more addition in the shape of a summary.

1. Poetry is to be reckoned among the Fine Arts; and possesses the attributes common to the class. These attributes are to be ascertained, in the first instance, with a view to the definition of Fine Art generally.

2. The source of such a definition is to be sought in the sphere of the human emotions; of which a certain number are properly Æsthetic, or Fine Art, Emotions. The governing circumstance is always pleasure; although often disguised by circumstances, and not unfrequently taking the shape of relief from pain: yet all pleasures, and all modes of alleviating pain are not æsthetic; and the specific marks of such as are properly so, need to be clearly ascertained.

3. The characteristic of Poetry as a species of Fine Art consists in employing Language as the medium; on which fact is suspended a numerous host of distinctive qualities. It brings poetry into close connection with all regions of knowledge; since nearly every kind of knowledge finds embodiment in speech. One consequence is the difficulty of disentangling the purely poetic effects from what belongs to the other species of communicated knowledge.

4. In such a complication, resort is had to contrasting definitions of those several departments that become entangled with poetry. As respects the *matter*, these are Science, Eloquence, Morality, Religion. As respects literary *form*, we have History, or Narrative, Description and Exposition; all which may assume both poetical and unpoetical forms. Poetry needs a subject, and, while it imparts its own form to that subject, it avails itself of any accidental advantages that the subject may intrinsically possess for aiding in the desired effect.

5. While the end of poetry can, with more or less difficulty, be distinguished from the ends of other species of verbal composition, its means can also be distinguished. The Rhetorical art provides a full examination of all the devices, verbal and other, for fulfilling the end of poetry, as such.

6. The scope of poetry is intimately combined with the three great attributes named, respectively,—Concreteness, Harmony, and Ideality—whose meanings, fully understood, go far to confine the poetical art within its legitimate boundaries. The discussion of Ideality in particular is especially instrumental for putting clearly the difference between poetic and unpoetic form.

7. The element of Verse enters into poetry in its fullest and most typical character. A modified form of the poetic species assumes the garb of prose, and though adapted to a difference of mood in the reader, has yet so much of the essence of poetry, as to be more properly included with it, than with any other class of literary compositions.

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The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

IT will be unnecessary to give the subject-matter of the remaining lessons in the course for Standard III., of which the syllabus appeared in the February issue of this magazine. For all the facts are detailed with sufficient fulness in the new edition of the 'Science Reader,' No. 1. This book may now be obtained of the publisher, Mr. Joseph Hughes. To restate those facts in these articles would be a needless repetition. I therefore proceed to the consideration of the work to be done in Standard IV.

At this stage, we have reached a point at which the easy conversational style should begin to give place to a more solid and serious treatment. The *general*

should now lead to the *particular*. Hitherto, that is to say, in Standards I., II., and III., it has been my aim to arouse a *desire* to know, rather than to burden such young minds with what *is* known. The purpose of the foregoing articles has been to excite a curiosity respecting the nature of the things around us.

It appears to me that the whole course of work throughout the school, so far as this subject of elementary science is concerned, resolves itself into three stages, viz. :—

1st. To create a *desire to know*.
2nd. To explain the processes by which we *get to know*.
3rd. To teach those facts and principles that are thought to *be known*.

Stage 1 is the aim of the teaching in Standards I., II., and III. Stage 2, in Standard IV. Stage 3, in Standards V., VI., and VII.

In Standard IV., therefore, I assume that the work throughout the year will be mainly to make known those various modes of investigation by which we arrive at scientific accuracy respecting the nature and properties of the various objects and phenomena around us. Here, again, our course of investigation naturally resolves itself into three stages, namely :—

1st. We make experiments.
2nd. We accurately record the facts resulting from such experiments.
3rd. We logically deduce conclusions; we enunciate the law or principle to which our facts have led us.

Do not let any teacher be alarmed at what sounds very formidable work for such little children as we find even in Standard IV. It is well that boys, aye, and girls too, should, as soon as possible, become familiar with that scientific process, by which alone all definite knowledge of any value is obtained.

Let me give an instance to show how extremely easy it is, even in the case of quite young children, to deduce a scientific truth by a process of investigation strictly scientific and logical, though very simple. Suppose I wish to evolve the rule or law respecting the inclined plane, that 'the power is to the weight as the perpendicular height of the plane is to the length of the incline.' Here we shall use apparatus —a model—with which to make experiments. The first thing to be done, therefore, is to describe this apparatus, *i.e.*, the *length* of the plane; the methods of varying the *height* of it; the character of the *weights*, etc., used; and the contrivance for the elimination of frictions.

I suppose every teacher has read Tyndall's 'Heat, a mode of Motion.' It will be seen there that the professor is going to use the thermo-electric pile. Well, he begins, *not* by at once making experiments, but by describing the apparatus: and, by the way, how exceedingly charming is that description! How clear and logical!

Well, having explained our model of the inclined plane, we proceed to make experiments. Knowing the height and length, we find that the power, represented by a descending weight of, say two pounds, maintains a weight represented by six pounds, in equilibrium. We record this fact, *i.e.*, write it on the blackboard. Vary the weights, and again record the result. Now change the height of the plane and get more facts. Having now obtained six or eight separate results of experiments and written them down accurately, draw the board round to the front of the class, and talk about them; reason about them; see if there is any general law or truth to which they point; if there is, let it be distinctly stated.

Now, I maintain there is nothing whatever in all this too difficult for ordinary Fourth Standard children. And if we accustom boys to this method of investigation, are we not adopting the only sure way of training the mind in 'habits of exact observation, statement, and reasoning,' as the Code of 1883 so well describes it?

As in the case of Standard III., I may state that the scheme of lessons for Standard IV. is based upon the contents of the 'Science Reader' for Standard IV., published by the editor of this magazine and written by myself. The following is the syllabus, with the number of lessons forming the year's course. The chapters are the contents of the book, and full-stops separate the various lessons.

CHAPTER I.

Matter, and elementary bodies. (One lesson.)

CHAPTER II.

The most common elementary bodies: Oxygen. Carbon. (Two lessons.)

CHAPTER III.

Hydrogen. Nitrogen. Composition of water. Composition of air. (Four lessons.)

CHAPTER IV.

Distinction between chemical and physical properties. Weight. Attraction of cohesion and the three states of matter. Indestructibility of matter. (Four lessons.)

CHAPTER V.

The mineral kingdom: rocks, minerals, and metals. Granite, clay, slate, and sandstone. (Two lessons.)

CHAPTER VI.

Limestones: different kinds; how formed. (One lesson.)

CHAPTER VII.

Metals: chief ores. The scientific principles involved in the smelting of iron. (Two lessons.)

CHAPTER VIII.

Force, work, and machines. The simple machines or mechanical powers. (Two lessons.)

CHAPTER IX.

The air: its physical properties, weight, and temperature. Thermometer. Barometer. (Three lessons.)

CHAPTER X.

The aqueous vapour in the air. (One lesson.)

CHAPTER XI.

Dew, clouds, and rain. Hail and snow. (Two lessons.)

CHAPTER XII.

The vegetable kingdom: parts of a flowering plant: root, stem, leaves. (One lesson.)

CHAPTER XIII.

Parts of a plant (continued): the flower; Wall-flower. Buttercup. Primrose. (Three lessons.)

CHAPTER XIV.

Products of a plant: distinction between organic and inorganic matter. Starch. Sugar. Oil (*i.e.*, vegetable). Gluten. (Five lessons.)

CHAPTER XV.

The animal kingdom: vertebrata and invertebrata. The five classes of vertebrata. Class V. Fishes. (Three lessons.)

CHAPTER XVI.

Amphibians (2). Reptiles. (Three lessons.)

CHAPTER XVII.

Birds (2). Mammals, insectivorous. Herbivorous. Carnivorous. (Five lessons.)

In the above course there are forty-four lessons. There are, however, several supplementary lessons that it will be necessary to give. For instance, a description of some of the apparatus used, such as the pneumatic trough (two lessons); the structure of flame (one lesson); the Bunsen burner (one lesson); a common spirit lamp (two lessons). In the early part of the course it will also be found necessary to give lessons upon such operations as evaporation, condensation, distillation, filtration, and precipitation.

(*To be continued.*)

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Article 106 (*b*)

Merit Grant in Infant Schools.

BY MRS. MORTIMER,

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LESSON—FOOD.

CLASS—CHILDREN OVER SIX.

I. *Introduction.*—What do you call the first meal you have in the morning? Breakfast.

What do we have for breakfast? Bread-and-butter, tea, coffee, milk, and sometimes fish, eggs, or bacon.

When do you next have anything to eat? At dinner time. What do you have for your dinner? Meat, potatoes, cabbage, and sometimes peas or beans. Do you have another meal during the day? Yes, we have tea. What do you have for your tea? Bread-and-butter, and sometimes marmalade or jam. Is that all? do you not drink anything? Oh, yes; we have tea, or hot milk, or cocoa.

Now tell me the different times during the day that you have meals. Breakfast, dinner, and tea time. How many times is that? Three. Is there not another meal? Yes, father and mother and grown-up people have supper. When do they have supper? At night when we are in bed.

Can you give me one name for all the different things you have for breakfast, dinner, and tea? Yes, they are called food. What do we do with the food? We eat it. Do we eat tea, coffee, cocoa, and milk? No, we drink those things. Tell me the names of some food we eat? Bread, meat, potatoes, cheese, cabbage. Now tell me the names of some we drink. Tea, coffee, cocoa, milk, water.

II. *Uses.*—How do you feel if you have not had any food for a long time? Very '*hungry*.' And how do you feel if you want something to drink? Very '*thirsty*.' Do you know why we eat and drink? Because we are hungry and thirsty. What does the food do for us? It makes us grow big and strong and keeps us from being ill. What would happen to us if we were not to have any food? We should be ill and die. Then you see food keeps us alive and makes us grow strong.

III. *Different kinds.*—Now I want you to think of all the different things we eat, and see if we can find out where they come from. First think of your dinner, what do you generally have? Meat and potatoes. Where does your mother get the meat? She buys it of the butcher. Tell me some different kinds of meat? Mutton, beef, pork, veal. What else do you have,—think of Christmas? Ducks, goose, turkey, fowl.

What do we call mutton? The flesh of the sheep. What is done to the sheep before the flesh is called mutton? It is killed. What is beef? What is pork? Yes, but the flesh of the pig is also called bacon. I will tell you the difference between pork and bacon. When the pig is killed the flesh is called pork. A great deal of this pork is salted and smoked by means of wood fires, and then it is called bacon. And what is veal? The flesh of calves. What are calves?

Can you give me one name for bullock, sheep, pig, duck, goose, turkey, fowl? Yes, they are all animals. Then you see all our meat is obtained from animals, and therefore we call it *animal food*. But there are also some other animals that we eat. Cannot you think of any? I am thinking of fish. Now tell me the name of some? Cod, herring, haddock, eels, and plaice. One little boy said bloaters. Well, you must remember they are dried herrings. Now name all the animal foods you know, and we will write the names on the blackboard.

What do you have for your dinner besides meat? Potatoes and cabbage. Try to think of something else. Beans, peas, turnips, carrots. Do you know what we call these things? Well, look at the word I am writing on the board, veg-e-ta-bles. Now what do we call them? Vegetables. How many kinds of food do you know? Two. What are they? Animal food and vegetable food. We will now write down all the vegetable foods you can think of. You said you had bread and milk for breakfast. From where does the bread come? From the baker. Do you know of what the baker makes the bread and from where the flour is obtained? Then under which kind of food shall we put the bread?

From where do we get the milk? From the cow. Then in which line shall we put milk? Then you eat butter. Who can tell me where we get butter? Of what is it made? Then where must we put butter? One little boy said he had an egg. Where do you get eggs? In which line shall we put eggs? In a similar manner the teacher should deal with the other things mentioned by the children.

IV. *Summary.*—This would consist of the two columns of names containing (*a*) animal food; (*b*) vegetable food.

The children then for an exercise should divide on their slates each class of food into (*a*) food for eating, (*b*) food for drinking.

Another exercise might be to require the children to point out the foods used at the different meals.

LESSON—THE ORANGE AND THE LEMON.

CLASS—CHILDREN OVER SIX.

Apparatus:—An orange and lemon. A picture of the trees.

The children should be asked to name these fruits, and then their attention should be directed to the orange.

I. *Description.*—What can you tell me about this orange? It is round. What colour is it? Of a reddish yellow colour. This kind of yellow we call orange colour. It is

also bright. If you feel it, what would you say? It is smooth, and rather soft.

Before you eat an orange, what do you have to do? Take off the outside. What is the outside called? The peel. Who can peel this orange? Do you peel it like you do an apple? No, you can pull the peel off the orange. And the apple? You must cut the peel off. Now let me look at the peel. What colour is inside? It is white. Yes; now look at the edge of the peel, and tell me whether the yellow or white part is the thicker? The white part. Yes; the yellow part is very thin. How does the yellow part taste? Very bitter. Do you eat the peel? No; it is not nice. Which part of the orange do you eat? The inside. Well, we will now look at the inside. What colour is it? Yellow. What covers the inside? A very thin skin; here is a piece of it, it is so thin that you can see through it. Now watch me; what am I doing? Breaking the orange into pieces. What do you notice about each piece? It has a thin skin all over it. Let us count how many of these pieces there are. How many? Ten. Sometimes there are nine, and sometimes eleven. Look at one of these pieces; what shape is it? It is half a circle. Yes; the outside of the half circle is very thick, and then it gradually gets thinner. Anything of this shape is said to be wedge-shaped. We will now break this skin, and then what do you see? Juice, pips, and the pulp. Which do you eat? The juice and the pulp. What do you do with the pips? Throw them away. Now look at the pulp; what can you say about it? It is yellow, very soft, and made up of a great number of little pieces; if you taste it, it is sweet. Are all oranges sweet? No; some are very sour. I suppose you do not like them, then?

II. *Uses.*—For what do we use oranges? For eating. Do we eat them for our dinner or tea? Oh no; we like to eat them at any time. When do you like an orange? When we are thirsty. Why? Because it is so juicy that it quenches our thirst. There is another use we make of oranges; do you know what it is? They are made into marmalade. What do we do with marmalade? Put it on our bread and eat it; it is something like jam. Then I daresay when you are eating cake you sometimes find some pieces of peel. The peel of the orange is used for this purpose after it has been preserved with sugar. This peel is also put in puddings.

III. *Where found.*—Do you know where we get oranges? They grow on a tree called the orange-tree. We do not see orange-trees growing in this country, for it is not warm enough to make the fruit nice; they grow in very warm countries. Do you know how we get them here? They are picked off the trees and packed very carefully in boxes, and then they are brought to England in ships. Who has seen one of these boxes of oranges? What have the oranges round them? They are wrapped in soft white paper. Do you know why this is done? To keep the oranges from rubbing and knocking against each other. What would happen if they did knock against each other? They would be bruised, and then they would go bad.

We will now talk about the lemon.

I. *Description.*—What can you tell me about it? Is it the same shape as the orange? No, it is not so round. Tell me something that is of the same shape. An egg. What do we say of things that are of this shape? That they are oval. Now, all of you repeat, 'The lemon is of an oval shape.' What about the colour of the lemon? It is lighter than the orange. Yes; we say the lemon is of a pale yellow colour; it is smooth and rather soft like an orange.

What part is this? The peel or rind. You see I can take the rind off just in the same way as I did the orange. Now look at the peel; what will you say? It is made up just like the orange, yellow outside, and a thick white part inside. Yes; and you must be very careful not to eat the white of the orange and lemon, for it is likely to make you ill. Now look at this part, and you will see that it is covered by a thin skin, just like the orange, and yet when you look at the inside of the lemon you can see a great difference. What is the difference? It is very pale in colour. How else does it resemble the orange? You are able to divide it up into a number of small pieces. Yes; count the pieces and tell me how many there are. Now look at one of the little pieces and tell me what you notice. We see that there are pips, pulp, and juice, just like the orange. Taste one of the pieces; does it taste like the orange? Oh no, it is very sour.

II. *Uses.*—For what do we use lemons? To make lemonade. For what do you use lemonade? For drinking. Why do you not eat lemons as you do oranges? Because they are so sour; we make a drink of them instead, and we put a great deal of sugar with them. For what else do we use lemons? They are sometimes made into marmalade, and they are used to flavour pies, cakes, etc. Lemon peel is also used like orange peel, to put into cakes, puddings, etc.

III. *Where found.*—Lemons grow on trees in warm countries, like the oranges, and they are sent to this country much in the same way. Lemons are wrapped in paper and packed carefully in boxes.

IV. *Summary.*—The orange and lemon have a peel; they are divided into parts. Each part contains pulp, pips, and juice.

They grow on trees in very warm countries.

The peel of the orange and lemon is used for flavouring.

The orange and lemon are made into marmalade.

The orange is round and the lemon is oval.

The orange is sweet and the lemon is very sour.

The orange is used for eating, and the lemon is made into lemonade.

This summary would have to be written on the blackboard at the end of the lesson, so as to make a comparison between the two fruits. It should be obtained from the children, and would thus serve as a recapitulatory exercise.

LESSON—THE OYSTER.

CLASS—CHILDREN OVER SIX.

Apparatus:—Oyster, a few shells, an oyster-knife.

I. *Description.*—The children should be shown an oyster, and asked to name it. What part of the oyster can you see? What part am I touching? The outside, or shell. Where is the oyster? Inside the shell. What can you say the shell of the oyster is? It is its home. Can you tell me the names of any other fish that live in shells? Yes, the periwinkle, whelk, mussel. Is the shell of the periwinkle like the shell of the oyster? Is it like the shell of any of these fish? No, it is very different. Here is an oyster shell, what can you say about it? It is of a brownish colour. It is rough. It is made up of different pieces. Yes, when a shell is like this, we say it is scaly. Now, look at the inside of this shell, what can you say about it? It is bright. It is of a white colour. Some parts look like pearls. Which side of the oyster shell is the prettier? The inside.

Now, look at this oyster, and tell me how many shells it has? It has two shells. Are they both alike? No, one shell is flat, and the other part is larger, and has a large hollow in it. Which shell is the flat one? The top one. Yes, and it is not as rough as the under, or lower one.

I will now open this oyster; do you know what I shall have to use? A knife. Will my penknife do? No, it is too sharp, and not strong enough. Yes, the oyster is very hard to open. What do you see inside the shell? An oyster. Where is it? In the large, or lower shell. Can you move the shell away easily? No, the oyster is joined to it. What must I do, then? You must cut the oyster away from the shell. Tell me something about this oyster. It is soft, cold, slippery, and of a light colour. Do you see these pieces of flesh lying along the shell? They form what is called the *mantle* of the oyster. If you look carefully at the mantle, you will see something along the edge. What can you see? The edge is nearly black. This is called the *beard* of the oyster, and forms the gills. For what do fish use their gills? To breathe with.

II. *Uses.*—For what do we use oysters? For eating. They are considered very good food, and sometimes, when people are ill, they are ordered to eat oysters. Do you know why? To help them to get strong.

Then there are some oysters that are very valuable, because of pretty little things found in the shell. They are called pearls. Have you heard of pearls? Have you seen any? Mary says, her sister has a pearl necklace, and another little girl says her mother has a box made of pearl. This pearl is the inside part of the shell of the oyster. The little pearls I was telling you about are used to put in rings, lockets, pins, etc. It would be well for the teacher to show the children some jewellery containing pearls, so as to help them to distinguish between these pearls and the mother-of-pearl used for buttons, knife handles, in inlaying wood, etc.

III. *Where found.*—Where do all fish live? In the water. Can you tell me what most fish do in the water? Swim about. Does the oyster swim about? The oyster is not able to swim. It fastens itself to a piece of rock or stone, and remains there. Which shell do you think is fastened to the rock? The bottom one. A great many oysters are found together, and the place where they are found is called an oyster-bed. How do you think we get the oysters from the bottom of the water? Well, I will tell you. Men take out a small net, fastened to a round ring of iron. They let this down to the bottom and then drag it along, and thus scoop up the oysters, and many other things that are in the water. The oysters are then picked out, and sent to the shops for us to buy. The oysters containing the beautiful pearl for making buttons, etc., are not found near our country. They are brought from places a very long way off.

IV. *Summary.*—This should be written on the board as the lesson proceeds, and should consist of simple words. It should then be copied by the children, or read, and afterwards written from memory.

An oyster lives in two shells in the water.

A part of the oyster is called the mantle. The gills are called the beard. The oyster is used for food.

The shells of some oysters are used for making buttons, handles of knives, pretty boxes. This substance is called mother-of-pearl.

Small pearls for rings, lockets, etc., are also found in oysters.

LESSON—THE SPIDER.

CLASS—CHILDREN OVER SIX.

Apparatus:—Picture or enlarged drawing of a Spider.

I. *Description.*—Children to be shown the picture, and to be asked what it is. Yes, it is a spider. Have you ever seen one? Where? Sometimes in the corners of the rooms. How do you know there is a spider in the corner? You see a cobweb. What does your mother do when she sees a cobweb? She gets a broom and sweeps it away. Why? Because it looks dirty and untidy. What does the poor little spider have to do then? It has to go somewhere else and make its web. You may sometimes see them in gardens, on bushes and trees, and if you ever go into a cellar you will be sure to see some there.

I want you now to look at this large picture of a spider, and tell me all you can about it. Look at its head, do you see how it is joined to its body? Yes; the spider has no neck, its head is joined on to its body without a neck.

What has the spider in front of its head? Two long horns. Well, they are something like horns, but we call them pincers. Repeat, 'The spider has a pair of pincers in front of its head.' Do you know the use of these to the spider? It uses them to catch its food. Now you may count its eyes. How many can you see? Eight; two in front, two on each side, and two at the top. I wonder what is the use of all these eyes to the spider. How many have you? Only two. Where are they? In front of our head. What do you do when you want to see something at the side of you, or behind you? Turn our heads. Well, you see the spider has no neck, therefore it cannot turn its head about like we can, so what has it to enable it to see all round? Eyes in different parts.

Now let us see how many legs it has. Eight. It will be easy to remember that the spider has eight eyes and eight legs. Look at the legs again. What do you see at the end of them? Yes, they are like two hooks, something like the pincers. Where are the pincers? Quite right. They are in front of the head.

II. *Habits.*—Children to be asked what the spider has to eat. Flies and other insects. How does it catch these? In its web. Would you like to know how it makes its web? Well, I will tell you. The spider has in its body some juice, very thick and sticky, something like treacle. What colour is treacle? This juice is not the same colour as treacle, it is quite white. It is of this juice that the spider makes its web. When it wants to weave its web, the juice comes out of its body through very tiny holes, and makes a kind of thread. A drawing of the web might be shown and examined, the teacher pointing out how the threads cross one another, and are fastened at the ends. Why does the spider weave its web? To catch its food. How is it that the flies go into this net? The web is so fine that as the fly goes along quickly it does not see it and so is caught in it. Where is the spider? He is somewhere very near waiting for some food; directly he sees the fly caught he walks round and round it, all the time winding a thread round to fasten its wings and legs; then the spider pierces the fly with its pincers, and sends some poison into the holes made; the fly is thus killed, and the spider has its food. He then mends the web and watches for another insect.

III. *Summary.*—The spider's head is joined to its body without a neck. The spider has a pair of pincers in front of its head. It has eight eyes and eight legs, furnished with two hooks something like its pincers.

The spider lives on flies, gnats, and other insects, which it catches in its web.

It weaves its web of a substance which comes out of its body through little holes.

This should be written on the blackboard as the lesson proceeds, and at the end carefully read through by the children. If convenient, the children should copy it on their slates.

LESSON—THE COD.

CLASS—CHILDREN OVER SIX.

Apparatus: If possible, a small Cod might be shown to the children, or a picture of one; some smaller fish.

I. *Description.*—The smaller fish, *e.g.*, herring, haddock, mackerel, plaice, etc., to be brought before the children, who should be asked to name them. The cod now to be shown. What kind of fish would you say this is? A large one. Do you know its name? Yes, it is a cod. This is a very small cod; most of them are about as long as this—(show length of 2½ feet or 3 feet, the average length of the cod), and there has been one caught as long as this (show length 5 feet 8 inches.) What can you now tell me about the cod? It is a large fish. Are they all the same size? No. Then we say they vary in size. Now look at the head of the cod. If you feel it what do you find out? It is very smooth. Look at its body, where is it thickest? In the middle. Repeat: The cod's body is thicker in the middle than it is at the ends. With what is it covered? With scales. What is the colour of its body? It is different in different parts—in some places of a greenish colour, and in other parts white. What can you tell me about its mouth? It is large, and do you see what it has at the end of the lower part of its mouth? We call this a *beard.* Have you ever seen any one with a beard? Yes, some of your fathers have beards.

Where do they have them? On their chins. If you were to look inside the cod's mouth, do you know what you would see? Teeth. Yes, a great many teeth—several rows of them. How many rows of teeth have you? Only one. Repeat, 'The cod has several rows of teeth.'

Now see what the cod has on its back. Fins. Let us count them. Three on the back, two at the gills, two on the breast, and two near the tail. What is the use of the fins?

II. *Habits and food.*—Where does the cod live? In the sea. Is it found near our own country? Yes, but it is still more common near countries a very long way from here—they are much colder countries than ours. Men go out in ships to these places to catch the fish. What are these men called? Have you ever seen any one fishing? What do they use to catch the fish? Sometimes a net, and sometimes a long line with a hook at the end. Well, the men who go to catch cod use a hook and line. Some men catch a great many cod. What do they do with them when they have caught them? They put them in the ship and then bring them home.

What does the cod get to eat in the sea? Fish. Yes, they eat small fish and worms. They also eat crabs. What are crabs? Yes, they are fish. With what are they covered? With shells. Do you know any other fish covered with shell? We call all these shell-fish. The cod is very fond of eating shell-fish.

III. *Uses.*—For what do we use the cod? For food. What does your mother do with it? Boil it. How does the fish look when it is cooked? Very firm and white; it is very nice to eat. There is one part of the fish that is sold by itself, do you know what it is? The roe. This also is very nice when it is cooked. Do you know any other use of the cod? Have any of you ever tasted cod-liver oil? Some of you have had some. Why did you have it? It is a medicine, and people take it to make them well and strong. We get cod-liver oil from the cod—there is one part inside the cod called liver. You all know what liver is, and it is from this part that the oil is obtained.

IV. *Summary.*—The cod is a large fish. Its head is very smooth.

The cod's body is thicker in the middle than at the ends.

It is covered with scales. The cod has a large mouth, with several rows of teeth. It has a beard.

The cod has nine fins.

The cod lives on small fish and worms. It also eats shell-fish.

The cod is used for food. Cod-liver oil is obtained from its liver.

This should be written on the black board as the lesson proceeds.

(To be continued.)

—o—

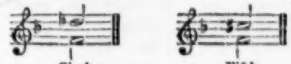
Music.

BY RALPH DUNSTAN, MUS. BAC., CANTAB.;
L. MUS., T.C.L.;
Member of the Council of the Tonic Sol-fa College, etc.

(Continued from page 17.)

DIATONIC AND CHROMATIC INTERVALS.—By the addition of the 'Chromatics,' **fe, ta, de, ma,** etc., to the natural diatonic scale, many new intervals can be formed. In reckoning such intervals it will be necessary to bear constantly in mind the rule laid down in treating of diatonic intervals, viz., *the name of the interval* (second, third, fifth, etc.) *is reckoned according to the number of included* DEGREES *of the scale.*

Thus the intervals, **d-m, d-ma, de-m,** and **de-ma** are all *thirds*, including the degrees **d, r, m,** or inflections of these; and, by the same rule, the interval **d-la** is a *sixth* (**d, r, m, f, s, la**), while the interval **d-se** is a *fifth* (**d, r, m, f, se**): the number of semitones in each of these intervals is the same, but the names are quite distinct.



Seconds, thirds, sixths, and sevenths, which are *greater than Major*, are said to be '*Augmented*'; when *less than Minor* they are '*Diminished.*'

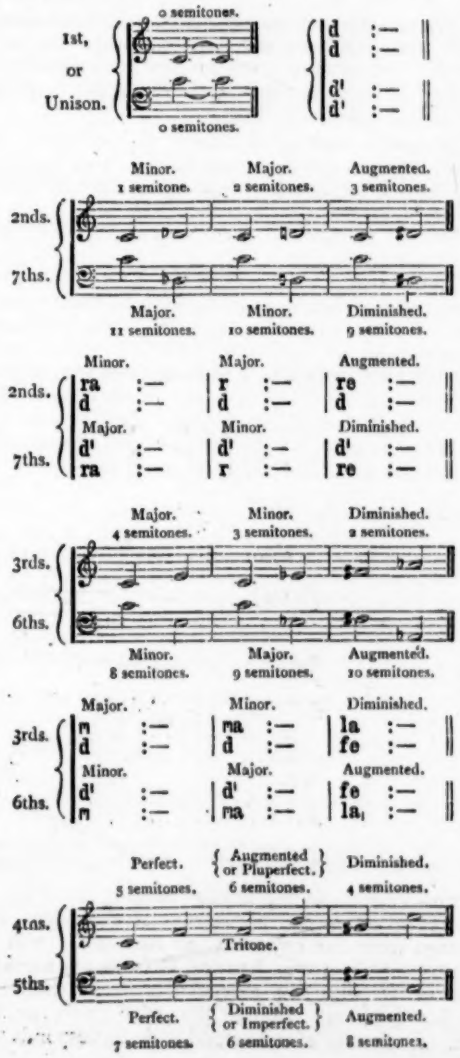
Fourths, fifths, and octaves, when *greater than perfect* are augmented or '*Pluperfect*,' when *less than perfect*, Diminished, or '*Imperfect.*'

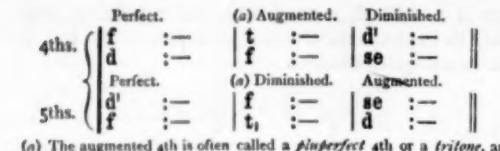
When 'inverted'

An *augmented*	interval	becomes	*diminished*
A *diminished*	,,	,,	*augmented*
A *pluperfect*	,,	,,	*imperfect*
An *imperfect*	,,	,,	*pluperfect*

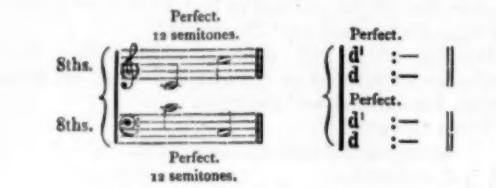
Table showing examples of the most important Diatonic and Chromatic intervals, with their Inversions and the number of included semitones.

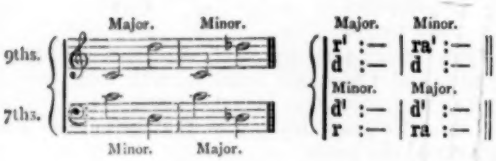
N.B.—The lower interval is the inversion of the higher, and *vice-versa.*


1st, or Unison.
0 semitones.
0 semitones.
d d :— ‖
d' d' :— ‖
Minor. 1 semitone. Major. 2 semitones. Augmented. 3 semitones.
2nds.
7ths.
Major. 11 semitones. Minor. 10 semitones. Diminished. 9 semitones.
2nds.
ra d :— | r d :— | re d :— ‖
7ths.
d' ra :— | d' r :— | d' re :— ‖
Major. 4 semitones. Minor. 3 semitones. Diminished. 2 semitones.
3rds.
6ths.
Minor. 8 semitones. Major. 9 semitones. Augmented. 10 semitones.
3rds.
m d :— | ma d :— | la fe :— ‖
6ths.
d' m :— | d' ma :— | fe la, :— ‖
Perfect. 5 semitones. Augmented or Pluperfect. 6 semitones. Diminished. 4 semitones.
4ths.
Tritone.
5ths.
Perfect. 7 semitones. Diminished or Imperfect. 6 semitones. Augmented. 8 semitones.



(a) The augmented 4th is often called a *plusperfect* 4th or a *tritone*, and the diminished 5th an *imperfect* 5th.





TRANSITION AND MODULATION.—Staff-Notationists and Solfa-ists have different meanings for these words. According to the former, *Modulation* is any change of key or mode, and *Transition* implies a sudden or violent modulation.

Mr. Curwen restricted the uses of these words and made their signification more definite, so that in Solfa language *Transition* is *change of key*, and *Modulation* is *change of mode*.

For the present we shall adhere to these latter definitions.

TRANSITION, OR CHANGE OF KEY.—The whole theory of Transition is best shown by what is called the 'Extended Modulator.' On this modulator several scales are printed side by side in such a manner that the scale immediately to the right of any particular scale represents a key or scale whose Tonic or Key-note is a perfect-fifth *higher* than the Tonic or Key-note of that scale, the *DOH* of the one corresponding in pitch to the *SOH* of the other; thus—

m'	l
r'	s
DOH'	f
TE	m
LAH	r
SOH	*DOH*
fe	t,
FAH	*ta*,
ME	l,
RAY	s,
DOH	f,

The *Transition* implied by changing from the first of these scales to the second is equivalent to a change from the key of C to that of G (with *one* sharp), or from the key of G (with *one* sharp) to that of D (with *two* sharps); or from the key of B flat (with *two* flats) to that of F (with *one* flat), etc. Each note of the second scale corresponds with a note of the first scale with the exception of *TE*; this note, which is of course a *semitone* below *DOH*, is not the equivalent of *FAH*, a *tone* below *SOH*, but of *FE* the sharp of *FAH*. In other words, the *FAH* of the old scale is *sharpened a semitone* to *FE*, which becomes the *leading note*, *TE*, of the new scale.

As there is only *one* note of the old scale changed, and this note is *sharpened*, the process of changing from the first scale to the second is called 'a Transition of *one sharp remove*:' and there is, of course, one *new* note, *TE*.

By extending the process of transition to the next scale—

r' ... s	d'
de' ... *fe*... ...	t
DOH' ... f	*ta*
TE... ... m	l
LAH ... r	s
SOH ... *DOH* ...	f
fe... ... t, ...	m
FAH *ta*, ...	
ME ... l, ...	r
RAY ... s, ...	*DOH*
de... ... *fe*, ...	t,
DOH ... f, ...	*ta*,

It will be seen that the new *DOH* is equivalent in pitch to the old *RAY* (the whole scale has been raised a *tone* or *Major Second*), and there are *two* notes in this scale which do not correspond to diatonic notes of the former, viz., *TE* and *ME*: this is called 'a Transition of *two* sharp removes.'

Let us now *reverse* the process, reading the Modulator from right to left instead of from left to right.

(2) (1)	
s ...	*DOH'*
...	*TE*
f ...	*ta*
m ...	*LAH*
r ...	*SOH*
DOH—FAH	
t, ...	*ME*
l, ...	*RAY*
s, ...	*DOH*

The *FAH* of the first scale becomes the *DOH* of the second, and the *TE* is lowered or flattened to *TA*, which becomes the *FAH* of the new scale. This is 'a Transition of one *flat* remove,' and the new note is *FAH*. Such a Transition which *lowers* the pitch of *DOH* a perfect fifth (or, what is the same thing, raises it a perfect fourth), is equivalent to a change of key from C to F (with *one* flat), or from F (with *one* flat) to B flat (with *two* flats), or from D (with *two* sharps) to G (with *one* sharp), etc.

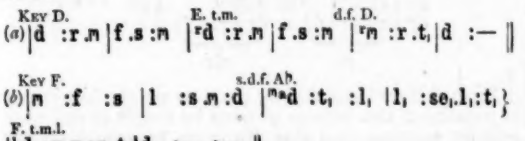
By repeating the same process we get 'a Transition of *two* flat removes,' where the *DOH* is lowered a Major second, and the two new notes are *FAH* and *DOH*.

The student should procure a small 'Extended Modulator' (Messrs. Curwen and Sons), and by

attentive examination and study of it verify and learn by heart the following table :—

KIND OF TRANSITION.	EFFECT ON DOH.	NEW NOTES.
1 sharp remove	Raised Perfect 5th	t
2 ,, removes	,, Major 2nd	t, m
3 ,, ,,	Lowered Minor 3rd	t, m, l
4 ,, ,,	Raised Major 3rd	t, m, l, r
5 ,, ,,	Lowered Minor 2nd	t, m, l, r, s
6 ,, ,,	Raised Augmented 4th	t, m, l, r, s, d
7 ,, ,,	,, Chromatic Semitone	t, m, l, r, s, d, f
1 flat remove	,, Perfect 4th	f
2 ,, removes	Lowered Major 2nd	f, d
3 ,, ,,	Raised Minor 3rd	f, d, s
4 ,, ,,	Lowered Major 3rd	f, d, s, r
5 ,, ,,	Raised Minor 2nd	f, d, s, r, l
6 ,, ,,	,, Diminished 5th	f, d, s, r, l, m
7 ,, ,,	Lowered Chromatic Semitone	f, d, s, r, l, m, t

In the notation of Transitions, besides the new key and the 'bridge-tone' already explained, the *new note* or notes should also be shown; in *sharp* Transitions the new notes are placed to the *right* of the name of the new key, and in *flat* transitions to the *left;* thus :—

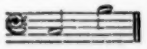


MODULATION is a change of Mode, as from Major to Minor, or from Minor to Major.

When a change of *Key* is accompanied by a change of *Mode* it is called a TRANSITIONAL MODULATION, as in Ex. (*b*) above.

When translating music from the Staff Notation to the Sol-fa, the 'unmarked' *DOH* for Treble and

Alto parts lies in this part of the Staff

and for Tenor and Bass parts in this 

To prevent the multiplicity of 'Octave-marks,' Tenor and Bass parts are, in Sol-fa, always written an octave *higher* than the real sounds signified.

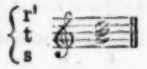
CHORDAL STRUCTURE OF THE SCALE.—When the notes **d, m, s,** are sounded together they produce what is called the '*Chord*' *of DOH.*

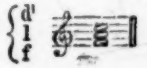
A *chord* is a combination of two or more notes sounded simultaneously, and the construction and treatment of chords form the basis of the theory of *Harmony.*

The 'Scale' is sometimes said to consist of the note of the Tonic, Dominant, and Sub-Dominant chords. These are,

In the Major Scale :—

(*a*) Chord of Tonic (or Chord of *DOH*) ... ... {s, m, d}

(*b*) Chord of Dominant (or Chord of *SOH*) ... ... {r', t, s} 

(*c*) Chord of Sub-Dominant (or Chord of *FAH*) ... ... {d', l, f} 

It will be seen that all the notes of the Major Scale are comprised in these three chords.

In the *Minor* Scale the corresponding chords are those of *LAH* (the Tonic), *SEME* (the Dominant), with *SE* instead of *SOH*, and *RAY* (the Sub-Dominant).

Chord of *LAH* {m, d, l,}

Chord of *SEME* {t, se, m}

Chord of *RAY* {l, f, r}

(To be continued.)

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Chemistry of the Non-Metallics.

BY EDWARD B. AVELING, D.SC. LONDON.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER III.—(*continued.*)

To sum up our simple table of weights and measures :

LENGTH.

Millimetre $\frac{1}{1000}$ metre about $\frac{1}{25}$ in.	*Metre* (39·37 in.)	Decametre 10 metres
Centimetre $\frac{1}{100}$ metre about $\frac{2}{5}$ in.		Hectometre 100 ,,
Decimetre $\frac{1}{10}$ metre about 4 in.		Kilometre 1000 ,,

VOLUME.

Millilitre $\frac{1}{1000}$ litre	*Litre* (1·765 imperial pints)	Decalitre 10 litres
Centilitre $\frac{1}{100}$,,		Hectolitre 100 ,,
Decilitre $\frac{1}{10}$,,		Kilolitre 1000 ,,

MASS.

Milligram $\frac{1}{1000}$ gram	*Gram* (15·432 grains)	Decagram 10 grams
Centigram $\frac{1}{100}$,,		Hectogram 100 ,,
Decigram $\frac{1}{10}$,,		Kilogram 1000 ,,
		about 2·205 lbs. av.

These weights and measures are in constant use in chemical laboratories, and in making chemical calculations. In connexion with every preparation and every reaction met with in our study of chemistry, these will be used. It is necessary, therefore, to at once familiarise the student with the working of these tables, and a few examples are taken before we proceed further.

EXERCISES ON WEIGHTS AND MEASURES, WITH SOLUTIONS.

(1) Find the equivalent in English measure of 3 kilometres, 2 hectometres.

3 kilometres = 3000 metres
2 hectometres = 200 metres
} = 3200 metres.

1 metre = 39·37 inches
3200 metres = 39·37 × 3200 inches = 125984 inches
125984 inches = 10498 feet 8 inches = 3499 yds. 1 ft. 8 ins.
= 1 mile 1739 yards 1 foot 8 inches.

(2) Find the equivalent in English measure of 1 hectolitre 7 decilitres.

1 hectolitre = 100 litres = 176·5 imperial pints
7 decilitres = $\frac{7}{10}$ litre = 7 × ·1765 = 1·2355 pints
} 177·7355.

177·7355 pints = 88·8677 quarts = 22·2169 gallons.

(3) Express 1 ton as its equivalent on the metric system.

1 ton = 20 cwt. = 2240 lbs. = 2240 × 7000 grains = 15680000 grains.

15·432 grains = 1 gram

1 grain = $\frac{1}{15{\cdot}432}$ = $\frac{10000}{154320}$ grams.

15680000 grains = $\frac{1000 \times 15680000}{15432}$ = $1016070\frac{9720}{15432}$ grams.

= 1016 kilograms 7 decagrams $\frac{9720}{15432}$ grams.

(4) The number of millimetres in 20·7 metres.

1 metre = 1000 millimetres

20·7 metres = 1000 × 20·7 = 20700 millimetres.

(5) The number of kilograms equivalent to 5004 milligrams.

1 milligram = $\frac{1}{1000}$ gram = $\frac{1}{1000} \times \frac{1}{1000}$ kilogram.

5004 milligrams = $\frac{1}{1000} \times \frac{1}{1000} \times 5004$ kilograms = $\frac{5004}{1000000}$ = ·005004 kilograms.

(6) The number of decalitres in 2000 centilitres.

1 centilitre = $\frac{1}{100}$ litre = $\frac{1}{100} \times \frac{1}{10}$ decalitre.

2000 centilitres = $\frac{1}{100} \times \frac{1}{10} \times 2000$ = 2 decalitres.

(7) The number of cubic centimetres (c.c.) in $5\frac{1}{2}$ litres.

1 litre = 1 cubic decimetre = 1000 c.c.

$5\frac{1}{2}$ litres = 1000 × $5\frac{1}{2}$ = 5500 c.c.

(8) The number of cubic metres in a kilolitre.

1 kilolitre = 1000 litres = 1000 cubic decimetres.

10 decimetres = 1 metre ∴ 1000 cubic decimetres = 1 cubic metre, and 1 kilolitre = 1 cubic metre.

(9) The weight of 2 hectolitres of distilled water.

1 hectolitre = 100 litres = 100 cubic decim. = 100 × 1000 c.c.

1 c.c. of distilled water weighs 1 gram.

∴ 1 hectolitre weighs 100 × 1000 grams = 100 kilograms, and 2 hectolitres weigh 200 kilograms.

(10) The weight of a kilolitre of a liquid of specific gravity 5.

(Water is the standard of reference for liquids.)

1 c.c. of water weighs 1 gram.

1 kilolitre = 1000 litres = 1000 × 1000 c.c.

∴ 1 kilolitre of water weighs 1000000 grams.

1 kilolitre of liquid of specific gravity 5 weighs 5000000 grams = 5000 kilograms.

EXAMPLES ON WEIGHTS AND MEASURES FOR SOLUTION.

(1) Find the English-system equivalents of the following (the answers are in *italics*) :—

(*a*) 27 metres ...	29 *yards*, 1 *foot*, 6·99 *inches*.
(*b*) 4 hectometres, 8 metres, 7 decimetres	446 *yards*, 2 *feet*, 10·519 *inches*.
(*c*) 1 centimetre ...	·3937 *inches (nearly* $\frac{3}{8}$ *inch)*.
(*d*) 1 millimetre ...	·03937 *inch (nearly* $\frac{1}{25}$ *inch)*.
(*e*) ·6 of a litre ...	1·059 *pints*.
(*f*) 7 kilolitres 7 millilitres	1544 *gallons*, 1 *quart*, 1·012355 *pints*.
(*g*) 2 cubic metres ...	441 *gallons*, 1 *quart*.
(*h*) 1 kilogram ...	2 lbs., 1432 *grains*
(*i*) 5·75 hectograms...	1 *lb.*, 1873·4 *grains*.
(*k*) 1 milligram ...	·015432 *grains*.

(2) Find the metric-system equivalents of the following :—

(*a*) 1 mile	1 *kilometre*, 6 *hectometres*, 9·3 *metres*.
(*b*) 1 foot	3 *decimetres*, ·4 *centimetres*.
(*c*) 1 inch	2 *centimetres*, 5 *millimetres*.
(*d*) 4 gallons	18 *litres*, 1 *decilitre*, 3 *centilitres*.
(*e*) 3 quarts	3 *litres*, 3 *decilitres*, 9 *centilitres*.
(*f*) 7 gallons, 2 quarts, 1 pint	3 *decalitres*, 4 *litres*, 5 *decilitres*, 6 *centilitres*.
(*g*) 1 lb.	4 *hectograms*, 5 *decagrams*, 3 *grams*, 6 *decigrams*.
(*h*) 3 qrs., 26 lbs. ...	49 *kilograms*, 8 *hectograms*, 9 *decagrams*, 6 *grams*.
(*i*) 7·716 grains ...	5 *decigrams*.

(3) Perform the following reductions :—

(*a*) 5 kilometres to millimetres ...	Ans.	5,000,000
(*b*) 84550 centimetres to kilometres ...	,,	·8455
(*c*) $9\frac{3}{4}$ metres to millimetres	,,	9750
(*d*) 2·8 litres to millilitres	,,	2800
(*e*) 6 kilolitres to centilitres	,,	600,000
(*f*) 7 decalitres to cubic centimetres ...	,,	70,000
(*g*) 3·5 litres to cubic centimetres ...	,,	3,500
(*h*) 9 kilograms to decigrams	,,	90,000
(*i*) 17564 milligrams to grams ...	,,	17·564
(*k*) 4 hectograms, 9 grams to milligrams	,,	409,000

(4) Find the weights of the following (the answers are in italics) :—

(*a*) Half a litre of distilled water ...	5 *hectograms*.
(*b*) A cubic decimetre of alcohol (sp. gr. = ·8)	8 *hectograms*.
(*c*) A cubic millimetre of mercury (sp. gr. = 13·5)	1 *centigram*, 3·5 *milligrams*.
(*d*) A cube of iron 3 decimetres in the side (sp. gr. = 7)	189 *kilograms*
(*e*) A rod of copper 2 metres long, section, 2 square c. m. (sp. gr. = 9)	3 *kilograms*, 6 *hectograms*.

The metric system of weights and measures once understood, we can turn again to our preparation of hydrogen. The symbols of the preparation of that element from zinc and sulphuric acid were : $Zn + H^2SO^4 = ZnSO^4 + H^2$. To calculate the proportionate weights of the substances employed and of the substances formed in this reaction, we turn to the table on p. 12. The weight-numbers of hydrogen, sulphur, oxygen given there are respectively, 1, 32, 16. The weight-number of zinc is 65. Hence that of sulphuric acid (H^2SO^4) = 1 × 2(H^2) + 32(S) + 16 × 4(O^4) = 2 + 32 + 64 = 98: and that of zinc sulphate ($ZnSO^4$) = 65(Zn) + 32(S) + 16 × 4(O^4) = 65 + 32 + 64 = 161. We re-write the equation with the weight-numbers beneath the symbols.

$$\begin{array}{lcl} Zn + H^2SO^4 & = & ZnSO^4 + H^2 \\ \underbrace{65 + 2 + 32 + 64} & = & \underbrace{65 + 32 + 64} + 2 \\ 98 & & 161 \end{array}$$

From this we learn that 65 parts by weight (say grams or pounds) of zinc require 98 parts by weight of sulphuric acid for solution, and that 161 parts by weight of zinc sulphate are formed while 2 parts by weight of hydrogen are liberated. These are the fixed proportions by weight. If more than 98 parts by weight of the acid are poured upon 65 of zinc, only 98 will be affected, and all above that number will be untouched. For example, if on 65 grams of zinc a hectogram of the acid are poured, 2 grams of acid will be left.

We are now in a position to make the first of our chemical calculations. Wherever a question is given upon the weights of materials employed or produced in any given reaction, three things are necessary to its solution. (1) The symbols of the reaction. (2) The general weight-numbers. (3) The particular calculation.

EXERCISES ON THE PREPARATION OF HYDROGEN FROM ZINC AND SULPHURIC ACID. (*Solved.*)

(11) 5 grams of hydrogen are required. How much zinc and sulphuric acid are necessary for its production?

$$\begin{array}{lcl} Zn + H^2SO^4 & = & ZnSO^4 + H^2 \\ 65 + 98 & = & 161 + 2 \end{array}$$

For 2 grams hydrogen, 65 grams zinc, and 98 grams sulphuric acid are needed.

1 ,, $\frac{65}{2}$,, $\frac{98}{2}$,,

5 ,, $\frac{65 \times 5}{2}$,, $\frac{98 \times 5}{2}$,,

∴ $\frac{325}{2}$ = 162½ grams zinc + $\frac{490}{2}$ = 245 grams of acid.

(12) What weight of hydrogen can be obtained from 9·8 grams of sulphuric acid?

98 grams sulphuric acid yield 2 grams hydrogen.

1 ,, ,, ,, yields $\frac{2}{98}$,, ,,

9·8 ,, ,, ,, yield $\frac{2}{98} \times \frac{98}{10}$ = ⅕ gram hydrogen.

(13) 13 grams of zinc are dissolved in sulphuric acid. What weight of zinc sulphate is formed?

65 grams of zinc dissolved yield 161 grams $ZnSO^4$

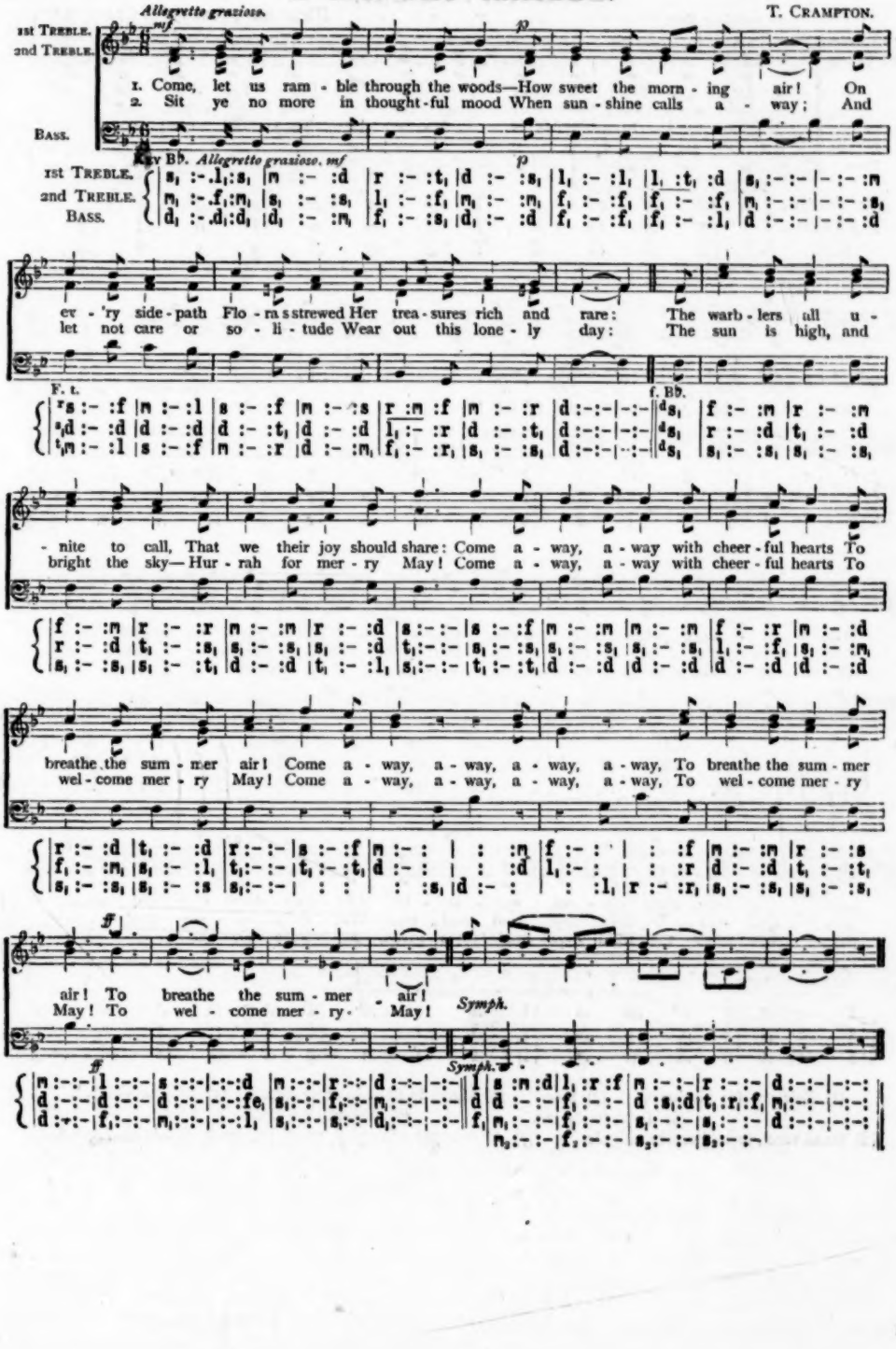
1 ,, ,, ,, yields $\frac{161}{65}$,, ,,

13 ,, ,, ,, yield $\frac{161 \times 13}{65}$ = 32½ grams.

(To be continued).

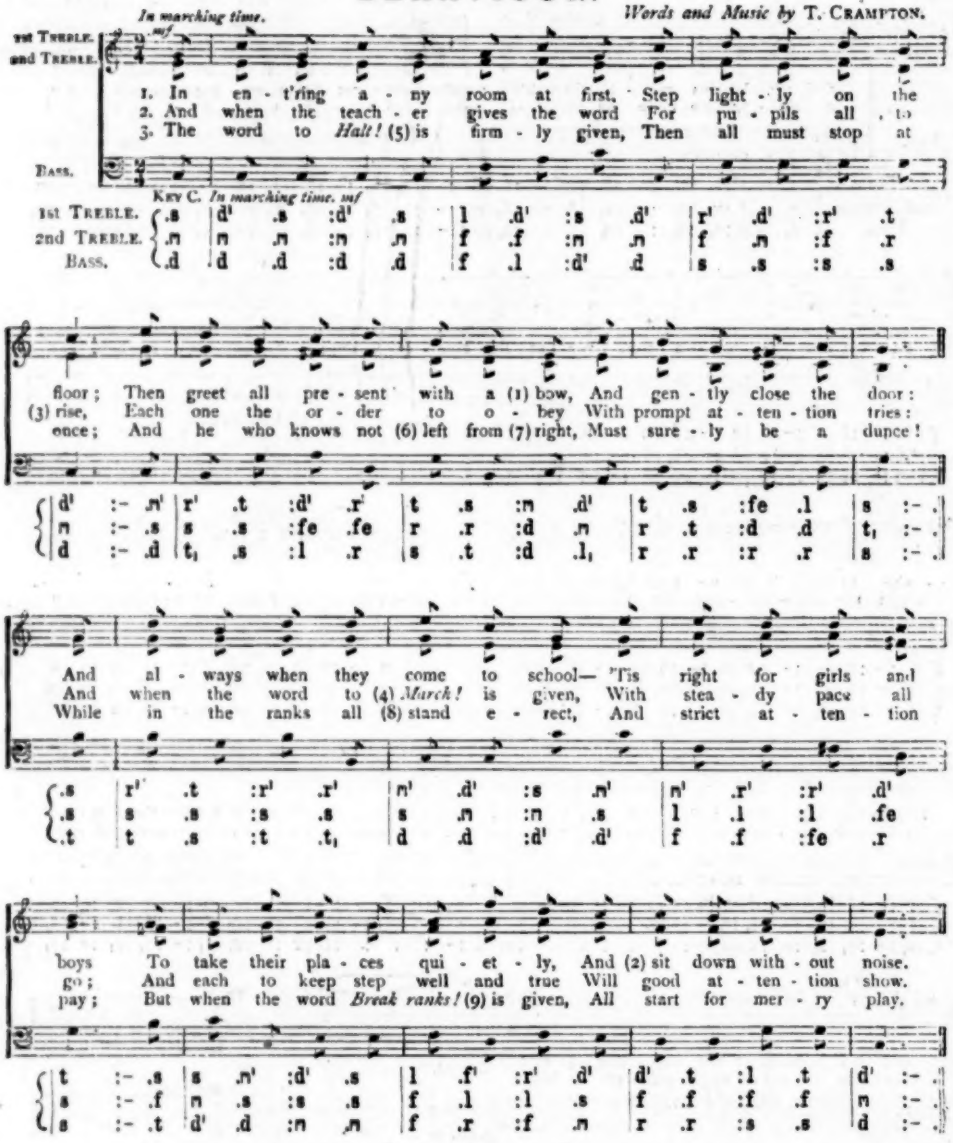
A MAY-DAY RAMBLE.

T. CRAMPTON.


Allegretto grazioso.
mf
p
1st TREBLE.
2nd TREBLE.
BASS.
1. Come, let us ram - ble through the woods—How sweet the morn - ing air! On
2. Sit ye no more in thought - ful mood When sun - shine calls a - way; And
Key Bb. Allegretto grazioso. mf
p
ev - 'ry side - path Flo - ra strewed Her trea - sures rich and rare: The warb - lers all u -
let not care or so - li - tude Wear out this lone - ly day: The sun is high, and
F. t.
f. Bb.
- nite to call, That we their joy should share: Come a - way, a - way with cheer - ful hearts To
bright the sky— Hur - rah for mer - ry May! Come a - way, a - way with cheer - ful hearts To
breathe the sum - mer air! Come a - way, a - way, a - way, a - way, To breathe the sum - mer
wel - come mer - ry May! Come a - way, a - way, a - way, a - way, To wel - come mer - ry
ff
air! To breathe the sum - mer air!
May! To wel - come mer - ry - May!
Symph.
Symph.

BEHAVIOUR.

In marching time. *mf* *Words and Music by* T. CRAMPTON.


1st TREBLE.
2nd TREBLE.
BASS.
1. In en - t'ring a - ny room at first, Step light - ly on the
2. And when the teach - er gives the word For pu - pils all to
3. The word to *Halt!* (5) is firm - ly given, Then all must stop at
floor; Then greet all pre - sent with a (1) bow, And gen - tly close the door:
(3) rise, Each one the or - der to o - bey With prompt at - ten - tion tries:
once; And he who knows not (6) left from (7) right, Must sure - ly be a dunce!
And al - ways when they come to school— 'Tis right for girls and
And when the word to (4) *March!* is given, With stea - dy pace all
While in the ranks all (8) stand e - rect, And strict at - ten - tion
boys To take their pla - ces qui - et - ly, And (2) sit down with - out noise.
go; And each to keep step well and true Will good at - ten - tion show.
pay; But when the word *Break ranks!* (9) is given, All start for mer - ry play.

Key C. *In marching time. mf*

1st TREBLE.	.s	d'	.s	:d'	.s	l	.d'	:s	.d'	r'	.d'	:r'	.t	d'	:-	.r'	r'	.t	:d'	.r'
2nd TREBLE.	.m	m	.m	:m	.m	f	.f	:m	.m	f	.m	:f	.r	m	:-	.s	s	.s	:fe	.fe
BASS.	.d	d	.d	:d	.d	f	.l	:d'	.d	s	.s	:s	.s	d	:-	.d	t,	.s	:l	.r
	t	:-	.s	s	.m'	:d'	.s	l	.f'	:r'	.d'	d'	.t	:l	.t	d'	:-	.r'	r'	.t	:d'	.r'
	s	:-	.f	m	.s	:s	.s	f	.l	:l	.s	f	.f	:f	.f	m	:-	.s	s	.s	:fe	.fe
	s	:-	.t	d'	.d	:m	.m	f	.r	:f	.m	r	.r	:s	.s	d	:-	.d	t,	.s	:l	.r
	.s	r'	.t	:r'	.r'	m'	.d'	:s	.m'	m'	.r'	:r'	.d'	m	:-	.s	s	.s	:s	.s
	.s	s	.s	:s	.s	s	.m	:m	.s	l	.l	:l	.fe	s	:-	.m	m	.s	:m	.s
	.t	t	.s	:t	.t,	d	.d	:d'	.d'	f	.f	:fe	.r	d	:-	.d	d	.d	:d'	.d'
	t	:-	.s	s	.m'	:d'	.s	l	.f'	:r'	.d'	d'	.t	:l	.t	d'	:-	.r'	r'	.t	:d'	.r'
	s	:-	.f	m	.s	:s	.s	f	.l	:l	.s	f	.f	:f	.f	m	:-	.s	s	.s	:fe	.fe
	s	:-	.t	d'	.d	:m	.m	f	.r	:f	.m	r	.r	:s	.s	d	:-	.d	t,	.s	:l	.r

(1) Bow. (2) Sit down. (3) Rise. (4) March in time, keeping step. (5) Stop suddenly.
(6) Point to the left. (7) Point to the right.
(8) Stand erect, in soldier-like attitude. (9) All scamper off to play, unless previously otherwise directed.

Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

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Functions of the Liver.—It will have been seen, from the study of the anatomy of the liver, that it is supplied with both venous and arterial blood the former from the portal vein, the latter from the hepatic artery. The venous blood supplying the greater part of the liver is brought from two sources—the alimentary canal and the spleen. The blood from the alimentary canal will vary in composition according to the stage of digestion and the character of the food. As a rule it is deficient in solid matters, especially in red corpuscles, owing to dilution with the water absorbed, but contains an excess of albumin. The blood from the spleen is deficient in red corpuscles, but contains an excess of white corpuscles; while the total amount of solids is decreased. The blood of the portal vein combines the peculiarities of its two sources.

The blood leaving the liver by the hepatic vein is, as a rule, thicker than ordinary venous blood. The fibrin, albumin, fats, and salts in it are diminished, while the extractive matter is increased.

The character of the blood entering and leaving the liver is important, as throwing considerable light on its functions. These functions may be summed up under three heads:

1. It secretes bile.
2. It forms glycogen.
3. It alters certain constituents of the blood, and probably, as a consequence of this,
4. It forms one of the chief sources of the bodily heat.

The secretion of bile is the most obvious, though probably not the most important of the hepatic functions.

Bile is a bright, golden-red liquid when not modified by retention in the gall-bladder. It has a bitter taste, and is alkaline in reaction. Its specific gravity varies from 1018 to 1025. When taken from the gall-bladder it always contains considerable mucus, but when taken directly from the hepatic duct there is little or none of this. Besides mucus, its chief constituents are—bile-salts, cholesterin, bile-pigment, and inorganic salts.

The average amount of these is shown in the accompanying table.

	In 100 parts.
Water	86
Bile-salts	9
Fats, etc.	1
Cholesterin	0·25
Mucus and Pigment	3·
Inorganic Salts	0·75
	100

Bile differs from all other alimentary secretions in containing no proteids. Among the salts is a considerable proportion of common salt, some phosphates, iron, manganese, and, occasionally, a trace of copper.

The *bile-pigment* present in healthy human bile is *bilirubin*, the composition of which is $C_{16}\ H_{18}\ N_2\ O_3$. The characteristic test for its presence (Gmelin's test) is the reaction obtained by adding a few drops of nitric acid to a little bile placed on a white plate. The yellowish-red becomes green, then in succession blue, violet, dirty red, and finally pale yellow. An alkaline solution of bilirubin exposed to the action of the air turns green, and becomes changed into *biliverdin*, which is the normal green pigment of the bile of herbivorous animals.

The bile occasionally vomited is green, and it is probable that biliverdin has been produced in it by the action of gastric juice. The bile pigments seem to be connected in their origin with the red corpuscles of the blood, and it is probable that they, on the other hand, produce the urinary pigment.

The *bile-salts* consist of sodium salts of glycocholic and taurocholic acids. The proportion of these two varies in different animals. In human bile the taurocholate of sodium exists almost to the exclusion of the glycocholate, while in ox-gall the reverse condition holds good. Both salts may be made to crystallise out of bile in needle-shaped crystals. They may be separated from a solution containing them both by sugar of lead, which throws down the glycocholate much more readily than the taurocholate. Both glycocholic and glycocholic acids are conjugate acids, consisting of cholalic acid conjugated in the first case with glycocholl, and in the second case with taurin. Glycocholl $= C_2\ H_5\ NO_2$, is amido-acetic acid, while taurin $= C_2\ H_7\ NSO_3$ is amido-ethyl-sulphuric acid. The decomposition of the biliary acids into the parts of which they are conjugated, occurs naturally in the intestine, taurin and glycocholl being returned to the circulation. The reaction may be expressed thus:

Glycocholic acid Water Cholalic acid Glycocholl.
$$C_{26}\ H_{43}\ NO_6 + H_2O = C_{24}\ H_{40}\ O_5 + C_2\ H_5\ NO_2$$

Taurocholic a id Water Cholalic acid Taurin.
$$C_{26}\ H_{45}\ NSO_4 + H_2O = C_{24}\ H_{40}\ O_5 + C_2\ H_7\ NSO_3$$

The presence of either of the bile salts or acids may be detected by the addition of cane-sugar and sulphuric acid, a magnificent purple being developed (Pettenkofer's test).

The bile has been credited with most important digestive action, but there can be no doubt that this is to a large extent a mistake. It has no solvent action on any article of diet, owing to the fact that it contains no ferment analogous to ptyalin, pepsin, or trypsin. It has, however, certain minor functions:—1. It facilitates *the emulsification of fats*, probably owing to its alkaline character. The pancreatic juice is, however, much more important in this respect. It is found that animals in whom the bile is drained away by a fistula (an opening artificially made communicating with the exterior) of the bile-duct, rapidly emaciate. This has been ascribed to the loss of the emulsifying power of bile; but it is possible that it may be due also to derangement of the glycogenic function of the liver.

2. It *saponifies fats* to a certain extent, in virtue of the choleate of soda it contains.

3. It seems *to favour absorption of emulsified fats* by the villi of the intestine, as in its absence this process is not so rapid.

4. It *prevents unnatural decomposition* of the intestinal contents, and thus is antiseptic in its effect.

5. It *stimulates peristalsis*, and is consequently slightly purgative. When the bile is absent or deficient in amount, constipation is common.

6. It is *recrementitious*, being an excretion of waste

matter, and not chiefly a digestive secretion. This is shown especially in the fætus. In intra-uterine life, the lungs and intestinal canal are inactive, and there is absolutely no respiration. At birth the intestine contains a large amount of thick bile, which forms the largest part of the *meconium* or fœtal fæces. Thus the liver excretes in fætal life the oxidisable materials which might have been excreted in an oxidised condition from the lungs, if respiration had been in action. It is possible that in extra-uterine life also, the bile is excreted from the liver as in part an effete material. That this is not entirely the case, is shown by the fæces of children and adults containing only about one-sixteenth part of the bile, and none of its essential part, the bile-salts. It is evident, then, that the larger proportion of the bile becomes absorbed from the intestinal mucous membrane, and, as it contains an excess of carbon and hydrogen, furnishes a valuable source of combustible material, which is eventually eliminated by the lungs and kidneys.

The *source of the bile* has been the subject of much discussion. Do the hepatic cells elaborate and secrete the biliary constituents, or simply filter them from the blood? According to Drs. Budd and G. Harley, only the bile-salts are formed in the liver, while the bile-pigment is formed in the blood. The evidence is somewhat dubious, but it seems, on the whole, to favour the view that both are formed in the hepatic cells. This is borne out (1) by analogy; in the case of the pancreas we shall find quite as complex an elaboration effected; and (2) by the fact that extirpation of the liver does not produce any accumulation of bile in the blood.

It is probable, however, that although the bile is in the main elaborated by the liver, some of its constituents are partially or completely formed in the blood. Thus, according to Dr. Austin Flint, cholesterin represents the waste matter of the nervous tissues. Bile-pigments arise from hæmoglobin, and only a very slight transformation is necessary. Glycocholl, again, is normally present in the liver, and taurin in certain tissues, so that the bile-salts may be formed in the liver if only cholalic acid is there produced.

The *glycogenic function of the liver* is most important in maintaining the general nutrition. When this function fails, and sugar is allowed to enter into the circulation in unlimited amount, the disease known as diabetes is produced, which generally proves fatal in the end.

Claude Bernard first proved that animals are sugar-producers as well as plants, and carnivora as well as herbivora. The sugar-producing function appears to begin in the liver as early as the third or fourth month of fœtal life; before this time, the placenta seems to perform a similar function. In the adult this function is chiefly confined to the liver, though all the tissues possess it in a slight degree. Sugar is not formed immediately, but an intermediate substance, known as glycogen.

Claude Bernard found that the quantity of sugar was much greater in the hepatic than the portal vein; also that when a stream of water had been driven through the portal vein, thus depriving the liver of its contained blood, the quantity of sugar went on increasing for some hours after death. It is evident from this, that the substance of the liver contains a large amount of some material capable of producing sugar.

Claude Bernard next found that if the liver of an animal was removed directly after death, cut up into small pieces and thrown into boiling water, the resulting infusion contained very little sugar, and the quantity did not go on increasing for several hours. The fluid, however, was milky in appearance, and contained *glycogen*, a substance which could be changed into sugar by means of saliva and gentle warmth. It is evident, therefore, that boiling the liver destroyed a ferment, which would otherwise have rapidly converted glycogen into sugar; and we may regard the liver as a storehouse of glycogen, which is converted by means of this ferment into sugar, as the system requires.

Glycogen is identical in composition with starch ($C_6 H_{10} O_5$). It is an amorphous powder, soluble in water, but insoluble in alcohol or ether. By means of saliva or pancreatic juice, or the special ferment contained in the liver, as well as by many dilute acids, it is converted into grape-sugar. It differs from starch in its solubility in water, and in giving a deep red colour on the addition of iodine.

The immediate *origin of glycogen* is from the hepatic cells. They form a storehouse in which it is reserved until required, just as in the vegetable world starch is stored in roots and tubers, to be liberated in spring as dextrose for purposes of growth. The ultimate origin of glycogen, however, is the food. During starvation it diminishes and finally disappears. The foods which most rapidly and greatly increase it are starchy and saccharine. It may, however, be produced from a meat diet, though in much smaller amount. This is shown in some of the severer forms of diabetes. In these, the formation of large quantities of sugar continues, when a strict meat diet is enforced. One must conclude, therefore, that sugar (and consequently glycogen) may be formed by the breaking down of nitrogenous material into urea and the carbohydrate.

The fate of hepatic glycogen is still somewhat involved in mystery. It has been held that it becomes converted into fat and into sugar.

The formation of fat from glycogen is difficult to understand from a chemical point of view. That such a conversion seems possible, however, is favoured (1) by experiments of Milne-Edwards, who found that bees were able to make their combs (composed of wax—a kind of fat) when fed solely on sugar; while, at the same time, they did not diminish in weight. (2) There can be no doubt that an increase of carbohydrate (starchy and saccharine) food does tend to produce corpulence; while (3) there is considerable fat in the hepatic cells. It is probable, however, that carbohydrate food increases fat by acting as a source of readily combustible material, thus saving the combustion of fatty material already contained in the tissues, rather than by being directly converted into fat.

The conversion of glycogen into sugar readily occurs, as already seen. Whether, however, this change occurs in the living animal or not is still in dispute; most physiologists holding with Claude Bernard that it is constantly going on, while Dr. Pavy maintains that it is a purely *post-mortem* phenomenon, and asserts that the blood in the hepatic vein does not contain more sugar than that in the portal vein. It is doubtless true that the hepatic vein blood does not contain during life the amount of sugar found after death; but the estimation of sugar in blood is difficult, and it seems

probable that the sugar, after being temporarily stored in the liver as glycogen, leaves it as sugar, in an amount varying with the requirements of the system.

But whether the glycogen leaves the liver as glycogen or as sugar, its ultimate fate is to be used in *building up new tissues*. This is abundantly shown by its presence in muscle, white corpuscles, brain, and in all growing parts. It forms an essential part of these, and is a source of combustible material, producing heat and force for the body. A certain percentage of sugar is always contained in the blood, and seems to form an essential constituent of it.

The liver has a peculiar power of arresting matters passing through it, which is not confined to glycogen. Thus metallic poisons tend to accumulate in it, before entering into the general circulation.

The glycogenic function of the liver is closely under the control of the central nervous system. This is shown by the fact that if the medulla oblongata of a rabbit be pricked at the point known as the vaso-motor centre, the urine of the animal speedily contains sugar—in fact, an artificial diabetes has been produced. It seems that when the nervous control is deranged, the retentive power of the hepatic cells for glycogen is annihilated, and sugar passes through the liver without any hindrance.

The liver plays an important part in *modifying the constitution of the blood*. Some of the red corpuscles appear to be broken down in it, and from their colouring matter is produced the bile and urinary pigments. It is highly probable that the main seat of the metabolic changes, resulting in the production of uric acid and urea from albuminoid materials, is in the liver; for when the liver is disordered, this metabolism is somewhat diminished. In a disease called acute atrophy of the liver, in which the secreting tissue of the liver becomes destroyed, urea and uric acid almost cease to be formed, and leucin and tyrosin—bodies intermediate between urea and albumin—take their place.

(To be continued.)

—o—

ANSWERS TO
Pupil Teachers' Examination Papers.

MARCH 29.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What is meant by a prime number, and by a composite number? When are two numbers said to be prime to each other? Write down (1) all the prime, (2) all the composite, numbers from 1 to 12, both inclusive.

A prime number is a *first number*, that is, one which is divisible only by itself or unity.

A composite number is one which is made up of two or more factors other than unity.

Two numbers are said to be prime to each other when neither will divide the other without a remainder.

(1) Prime numbers:—1, 2, 3, 5, 7, 11.
(2) Composite numbers:—4, 6, 8, 9, 10, 12.

2. What decimal of £2 5s. is equal to 13s. 7½d.; and what is the value in weight of ·428517 of ·78125 cwt.?

(*a*) Fraction required = 13s. 7½d. ÷ £2 5s.

$$= \frac{13s.\ 7\tfrac{1}{2}d.}{45}$$
$$= \frac{13\frac{1}{2}}{45}$$
$$= \frac{109}{360} = 3{\cdot}027. \text{ Ans.}$$

(*b*) ·428517 of ·78125 cwt.
$= \frac{428517}{1000000} \times \frac{78125}{100000}$
$= \frac{3}{7} \times \frac{25}{32}$
$= \frac{75}{224}$
$=$ 1 qr. 9 lbs. 8 ozs. Ans.

3. Find the value of $\cdot1\dot{3}\dot{5} \times 50{\cdot}8\dot{3} \div {\cdot}04\dot{6}9\dot{1}$.

$$\cdot1\dot{3}\dot{5} \times 50{\cdot}8\dot{3} \div {\cdot}04\dot{6}9\dot{1}$$
$$= \frac{135-1}{990} \times \frac{5083-508}{90} \div \frac{4691-4}{99900}$$
$$= \frac{134}{990} \times \frac{4575}{90} \times \frac{99900}{4687}$$
$$= \frac{1005}{7}$$
$$= 168{\cdot}18. \text{ Ans.}$$

4. If A can do ⅔ of a piece of work in 5½ days, and B ⅘ of it in 4½ days, how much longer would A take to do the whole work than B would take?

Time for A to do ⅔ work = 5½ days.
" " ½ " $= \frac{5\frac{1}{2}}{3}$
" " ⅙ " $= \frac{5\frac{1}{2} \times 4}{3} = 7\frac{1}{3}$ days.
Time for B to do ⅘ work = 4½ days.
" " ⅕ " $= \frac{4\frac{1}{2}}{5}$
" " ⅐ " $\frac{4\frac{1}{2} \times 7}{5} = 6\frac{3}{10}$ days.

∴ A would take longer than B, $7\frac{1}{3} - 6\frac{3}{10} = 1\frac{1}{30}$ days. Ans.

FEMALES.

1. Find the cost of 214 acres 3 r. 29 poles at £125 7s. 6d. per acre.

	£	s.	d.	
2 r. = ½ acre	125	7	6	= cost of 1 acre.
	214			
	26,830	5	0	= cost of 214 acres.
1 r. = ½ of 2 r.	62	13	9	= " 2 roods.
20 p. = ½ of 1 r.	31	6	10½	= " 1 rood.
5 p. = ¼ of 20 p.	15	13	5¼	= " 20 poles.
4 p. = ⅕ of 20 p.	3	18	4⅕	= " 5 poles.
	3	2	8⅘	= " 4 poles.
£	26,947	0	1⅘	= cost of 214 a. 3 r. 29 ps.

2. Make out the following bill:—

11¼ yds. muslin at 1s. 3d. per yd.
3½ yds. calico at 8½d. per yd.
16½ yds. flannel at 1s. 4d. per yd.
20½ yds. calico at 8½ per yd.
13¾ yds. print at 7½ per yd.
20 yds. sheeting at 1s. 6½d. per yd.
1 gross reels of cotton at 9d. per dozen.

Glasgow, March 29th, 1884.

Mr. Wm. Davey.
Bought of STEWART MCDONALD.

	£	s.	d.
11¼ yds. muslin at 1s. 3d. per yd. ...	0	14	0¾
3½ yds. calico at 8½d. per yd. ...	0	2	6¼
16½ yds. flannel at 1s 4d. per yd. ...	1	1	8
20½ yds. calico at 8½d. per yd. ..	0	14	6¼
13¾ yds. print at 7½ per yd. ...	0	8	7½
20 yds. sheeting at 1s. 6½d. per yd.	1	10	10
1 gross reels of cotton at 9d. per dozen ...	0	9	0
	£5	1	2¼

3. Find the value of $3 + \frac{2}{3} + 1\frac{1}{2} + \frac{3}{4} + 103\frac{1}{3}$.

$$3 + \tfrac{2}{3} + 1\tfrac{1}{2} + \tfrac{3}{4} + 103\tfrac{1}{3}$$
$$= 107\frac{30+9+8+12}{36}$$
$$= 107\tfrac{59}{36}$$
$$= 108\tfrac{23}{36}. \text{ Ans.}$$

4. What is the shortest length of a wall that can be *exactly* measured with tapes either of 54, 216, or 168 inches in length?

Length required = L.C.M. of 54, 216, 168.

6	54, 216, 168
9	9, 36, 28
4	1, 4, 28
	1, 1, 7

$6 \times 9 \times 4 \times 7 = 1512$ inches. Ans.

Grammar.

MALES AND FEMALES.

1. *What* wicked and *dissembling* glass *of mine*,
Made me *compare* with Hermia's sphery *eyne*?
(Midsummer Night's Dream.)

Unruly *murmurs*, or ill-timed *applause*,
Wrong the *best* speaker, and the justest cause.
POPE.

Analyse the first of these sentences, and parse all the words in both printed in italics.

SUBJECT.	PREDICATE.	OBJECT.	EXTENSION.
What wicked and dissembling glass of mine	made	me Dir. Obj. compare with Hermia's sphery eyne Ind. Obj.	

What—interrog. pro., used as an adj. of distinction qualifying 'glass.'
dissembling—pres. part. of 'to dissemble,' used as an adj. of quality, qualifying 'glass.'
of—prep. showing reln. between 'glasses' und. and 'glass.'
mine—pers. pro., masc. (or fem.), 1st, sing., poss., gov. by 'glasses' und.
or, poss. pro., masc. (or fem.), sing., obj., gov. by 'of.'
compare—reg. int. verb, inf. mood., pres. tense, gov. by the verb 'made.'
eyne—com. noun, plu. no., neut., 3rd, obj., gov. by prep. 'with.'
murmurs—com. noun, plu., neut., 3rd, nom. to 'wrong.'
applause—com. noun, sing., neut., 3rd, nom. to 'wrongs,' included in the word 'wrong.'
wrong—reg. trans. verb, act., ind., pres., 3rd, sing., agreeing with its nom. 'murmurs.'
best—adj. of quality, superlative deg., qualg. 'speaker.'

2. What old plural ending do you notice in the above? Give similar instances.

Eyne for *eyes*; *hosen* and *hone* for *hose*; *treen* for *trees*; *pesen* for *peas*; *toon* for *toes*; *shoon* for shoes; *housen* for *houses*.

3. Mention some common terminations of English adjectives, with examples.

en, as—golden, wooden, hempen.
ful, as—playful, hurtful, wonderful.
ish, as—whitish, blackish, boyish.
less, as—houseless, fatherless, friendless.
ly, as—lovely, daily, weekly.
some, as—handsome, winsome, frolicsome.
ward, as—homeward, rearward, backward.
y, as—mighty, stormy, windy.

Geography.

1. How should you explain the following passage to a class, which had read it as part of a reading lesson? Draw out fully the points to be explained.

'The Cotswolds, though not very high, fill an important place. They are the chief water-parting of Southern England; for they lie between the two chief river-basins, those of the Severn and the Thames. From these, in tracing the boundaries of the *Eastern* section of England, we proceed over the north-eastern shoulder of the central table-land, pass between the Avon and the Welland, the Trent and the Witham, and end on the eastern side of the Lincolnshire Wolds.'

Use the map after reading through the piece, to show the position of mountains and rivers mentioned. Then draw *map* and *section* on blackboard. Explain, or elicit if already known, the meaning of *water-parting*, *river-basins*, and *shoulder of table-land*.

A *water-parting* is the high land which divides the land drained by different rivers. (Illus. roof of a house.) A *river-basin*, the whole of the land drained by a river and its tributaries. (Illus. from district if suitable; if not, the collection of the water from different parts of the roof of a house.) *Shoulder of table-land*, the highest part of the rising ground before the table-land or elevated plain is reached. (Illus., any hill, if one in neighbourhood.) Eastern section of England:—Eastern division.

2. Describe the journey of a traveller, starting from Adelaide, following the course of the Murray or the Darling, reaching Sydney by land, and returning to Adelaide by sea.
Illustrate your answer by a map.
Insert the lines of latitude and longitude.

Leaving Adelaide, the capital of South Australia and a fine thriving city of 40,000 inhabitants, a steamer sailing southwards would pass Kangaroo Island, and enter Encounter Bay. Then sailing northwards it would pass through Lake Alexandrina. Two hundred miles from the mouth of the river, a sudden turn to the east would be made, and 400 miles further from the coast, the junction of the Murray and Darling would be reached. Nearly the whole course of the Murray (2400 miles) is navigable. Leaving the Murray for the Lachlan, the steamer would reach within 300 miles of Bathurst, a town of 20,000 inhabitants, noted for its copper mines.

Sydney would be reached by land. This town is situated on Port Jackson, one of the finest harbours in the world, and has a population of nearly a quarter of a million. Taking steamer again, a traveller would sail southwards, along the coast of New South Wales to Cape Howe, then westwards, through Bass' Strait, past the entrance to Port Philip, on which stands Melbourne, capital of Victoria, and the largest city in Australia. The whole of the coast of Victoria would be skirted, and after a north-westerly course from Cape Otway, St. Vincent Gulf, and Adelaide, would again be reached. The whole distance travelled would be upwards of 5000 miles.

History.

1. How often did Julius Cæsar invade this country, and in what years?

Julius Cæsar invaded this country twice:—
First, in 55 B.C., when he ravaged the southern counties, defeated the British in two battles, took hostages, and then returned to Gaul. *Second*, in 54 B.C., when he again defeated the Britons under Cassivelaunus, settled the amount of tribute to be paid, took hostages, and retired to Gaul.

2. Some writers called Egbert the first King of England, and others give that title to Athelstan; which would you say, and on what grounds?

Although Egbert gained paramount authority over the other Saxon kings (Kent, East Anglia, and Northumbria,) his authority was very often disputed or despised. He never styled himself 'King of England,' but was contented with the titles of 'King of Wessex' and 'Bretwalda.' On the other hand Athelstan may be said to have reigned with undisputed sway after the battle of Brunanburgh. He also styled himself 'King of the Anglo-Saxons,' and 'King of the English.'
For these reasons, I should give the title to Athelstan.

3. Whom did Ethelred the Unready marry, and how did he treat the Danes? Trace some of the consequences of the two events.

Ethelred married Emma, sister of Richard II., of Normandy. He attempted to buy off the hostility of the Danes by presents of money. Year by year, however, they came in greater numbers, till, in 1002, he resolved on their massacre. In many places they were all destroyed. Among others, Gunhilda, sister of the King of Denmark, was killed. To revenge her death, Sweyn came over to England, and Ethelred was compelled to flee to Normandy, a refuge having been provided for him by his father-in-law. Ethelred returned after the death of Sweyn, taking with him many Normans, who were thus introduced into Britain. The connection became more intimate between the two courts till England was eventually invaded from Normandy by William the Conqueror.

Composition.

Write from memory the substance of the passage read to you by the Inspector.

Just as we were leaving our post of observation in despair, the sharp, distinct snap of a bough in the forest at our backs set our hearts beating. Everything was still and motionless for ten minutes more, when, about 200 yards below us, moving slowly and silently as a shadow, we made out a huge brown form looking twice its real size in the dim light. The mysterious way in which the bear appears straight from the dark recesses of the woods or the distant peaks, where he has been keeping out of sight all day; his slow, solemn movements, and the absolute silence he keeps, makes him different from all other beasts. The boar cannot help grunting out his satisfaction, or holding converse with his kind; the wolf and jackal make night hideous with their howlings; every other beast is more or less noisy, but Bruin alone steps out of the darkness, silent as a shadow, to return as noiselessly as he came.

Needlework.

FEMALES.

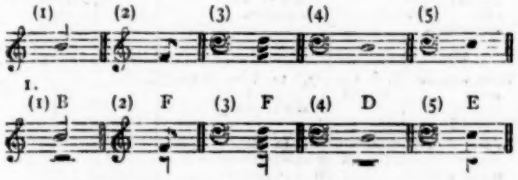
One hour will be allowed for this exercise.

Music.

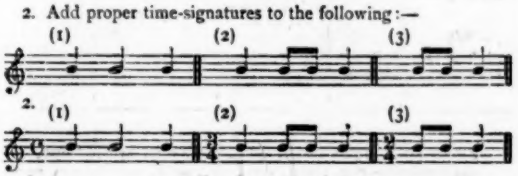
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

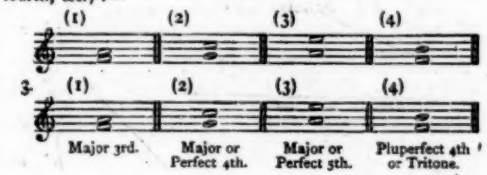
1. Write above each of the following notes its pitch-name (C, D), and below write the signs for rests corresponding in value to the notes :—



2. Add proper time-signatures to the following :—



3. Write below each of the following intervals its name (major fourth, &c.) :—



TONIC SOL-FA NOTATION.

1. Write a four-pulse tone, using two-pulse measure.

1. |d :— |— :— ‖

2. Write the names of the following intervals :—(1) *fah* to *lah*; (2) *soh* to *doh*^{1}; (3) *lah* to *me*^{1}; (4) *fah* to *te*.

2. (1) Major 3rd; (2) Perfect 4th; (3) Perfect 5th; (4) Pluperfect 4th or Tritone.

3. Write the following an octave lower, and state what is meant by the direction Key F :—

Key F.

m^1 r^1 d^1 t r^1 l s t d^1

3. Key F.

m r d t_1 r l_1 s_1 t_1 d

"Key F" means that the Tonic or key-note of the scale is F. The sound of F in the scale must be found and called *Doh*.

SECOND YEAR.

Pupil Teachers at end of Second Year.

FIRST PAPER.

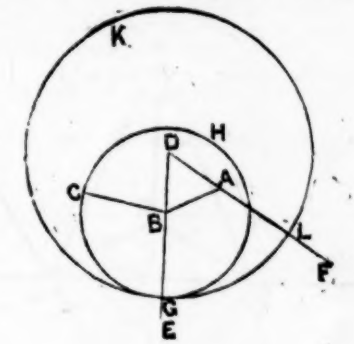
Three hours and a half allowed for this Paper.

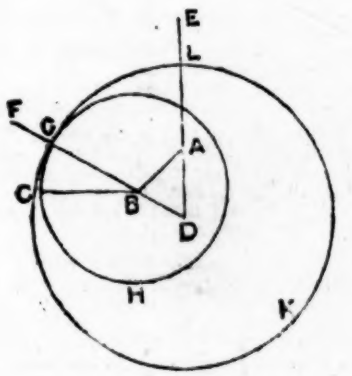
Euclid.

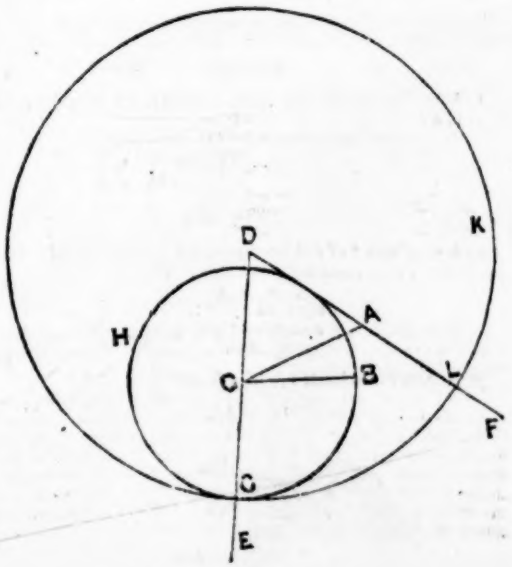
MALES.

[All generally understood abbreviations for *words* may be used.]

1. From a given point, to draw a straight line equal to a given straight line. When the given point is neither in the line







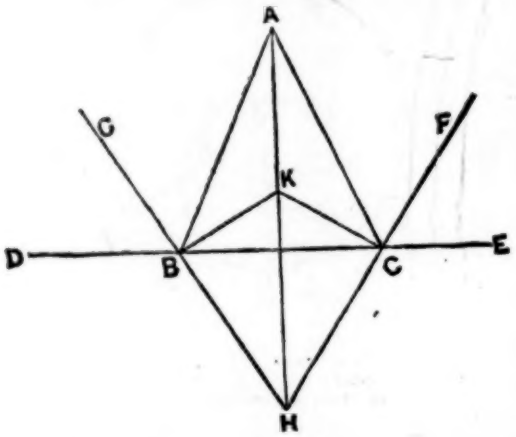
nor in the line produced, show by diagrams that there are several ways in which the line may be drawn.

Prop. 2, Bk. I.

2. If from the ends of a side of a triangle there be drawn two straight lines to a point within the triangle, these shall be less than the other two sides of the triangle, but shall contain a greater angle.

Prop. 21, Bk. I.

3. Show that the vertex of an isosceles triangle and the intersections of the bisectors of the interior and exterior angles at the base are in the same straight line.



In the isosceles triangle ABC let the exterior ∠'s be bisected by FC and GB, which produced intersect in H, and the interior ∠'s be bisected by BK and CK intersecting in K. Join AK, KH. Then AK, KH are in the same straight line.

The ∠'s ACE, ACB=2 right ∠'s, and the ∠'s ABC, ABD=2 right ∠'s. And ACB=ABC (I. 5.)

∴ ACE=ABD

And halves of=things are=. ∴ ∠ FCE= ∠ GBD

∴ ∠ HBC= ∠ HCB (I. 15) ∴ HB=HC (I. 6)

And BK=KC (I. 6) ∴ ∠ HKB= ∠ HKC.

And ∠ BKA= ∠ CKA (I. 8). ∴ ∠'s HKB, BKA= ∠'s HKC, CKA. And ∴ ∠'s HKB, BKA=2 right ∠'s.

∴ HK, KA are in the same straight line (I. 14).

Q. E. D.

Arithmetic.

FEMALES.

1. What fraction must be added to $2\frac{1}{3}$, $1\frac{3}{7}$, $3\frac{5}{12}$ to make a sum total of 8?

$$\text{Fraction required} = 8 - (2\tfrac{1}{3} + 1\tfrac{3}{7} + 3\tfrac{5}{12})$$
$$= 8 - \left(6\frac{28+36+35}{84}\right)$$
$$= 8 - 7\tfrac{19}{84}$$
$$= \underline{\tfrac{65}{84}}. \text{ Ans.}$$

2. A man buys $\frac{3}{8}$ of a ship's cargo for £2535 10s. 0d. How much of the ship could be bought for £3688?

£ s. £
2535 10 : 3688 :: $\frac{3}{8}$: x

$$x = \frac{3}{8} \times \frac{3688}{2535\frac{1}{2}} = \underline{\tfrac{11}{26}}. \text{ Ans.}$$

3. Reduce to decimals $1\frac{5}{12}$ of $5\frac{1}{12}$ and $\frac{2\frac{2}{3}}{3\frac{1}{3}}$.

$$1\tfrac{5}{12} \text{ of } 5\tfrac{1}{12} = \tfrac{17}{12} \times \tfrac{61}{12} = \tfrac{1037}{144} = \underline{6{\cdot}25}. \text{ Ans.}$$

$$\frac{2\frac{2}{3}}{3\frac{1}{3}} = \tfrac{8}{9} \times \tfrac{3}{10} = \tfrac{24}{90} = \underline{\cdot 266}. \text{ Ans.}$$

4. Add together $1\frac{3}{5}$ weeks, $2\frac{3}{4}$ days, $\frac{4}{5}$ of an hour, $10\frac{1}{2}$ minutes, and 33 seconds.

	wk.	dys.	hrs.	mins.	secs.
$1\frac{3}{5}$ wks. =	1	4	4	48	0
$2\frac{3}{4}$ dys. =		2	18	0	0
$\frac{4}{5}$ hr. =				42	$51\frac{3}{7}$
$10\frac{1}{2}$ mins. =				10	40
33 secs. =					33
	1	6	23	42	$4\frac{3}{7}$. Ans.

Grammar.

MALES AND FEMALES.

1. It is good in discourse, and *speech* of conversation, to vary and *intermingle* speech of the present occasion with arguments; tales with reasons; *asking of questions with telling of opinions*; and *jest* with earnest. (*Bacon's Essays.*)

2. Analyse the above, parsing the words in italics.

3. Point out, and explain, all the Latin prefixes in the above.

(1) ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Object.	Extension.
(*a*) It is good in discourse and speech of conversation to vary and intermingle speech of the present occasion with arguments.	Principal Sent.	It, to vary and intermingle speech of the present occasion with arguments in discourse and speech of conversation.	is good		
(*b*) Tales with reasons	P. S. contracted	[It, to intermingle] tales with reason	[is good]		
(*c*) Asking of questions with telling of opinions	P. S. contracted	[It, to intermingle] asking of questions with telling of opinions	[is good]		
(*d*) And jest with earnest	P. S. contracted	[It, to intermingle] jest with earnest	[is good]		

PARSING.

speech—abs. noun, neut., sing., obj., gov. by 'in' und.

intermingle—reg. trans. verb, inf., pres., used as abs. noun, neut., sing., nom. to 'is,' in apposition with 'it.'

asking—pres. part. of 'to ask,' used as verbal or abs. noun, neut., sing., obj., gov. by 'to intermingle.'

of—prep., showing relation between 'asking' and 'questions.'

questions—com. noun., neut., plural, obj., gov. by 'of.'

with—prep., showing relation between 'asking' and 'telling.'

telling—pres. part. of 'to tell,' used as verbal or abs. noun, neut., sing., obj., gov. by 'with.'

of—prep., showing relation between 'opinions' and 'telling.'

opinions—com. noun, neut., plural, obj., gov. by 'of.'

jest—abs. noun, neut., sing., obj., gov. by 'to intermingle.'

(2) *dis*—meaning *to and fro*. Discourse is that speech which passes from one to another.

con—meaning *together*; conversation is talk in which words are turned over together.

inter—meaning *among*; intermingle, to mix up together.

pre—meaning *before*; present—to be before, at this time; now.

oc—meaning *in the way of*, occasion—that which happens or falls in the way; an opportunity.

4. Paraphrase the following lines:—

Silence is the perfectest herald of joy;
I were but little happy could I say how much.

Excess of joy is most surely shown in the absence of all desire for speech. I should have but a small amount of happiness if I were able to say how happy I am.

Geography.

Answer two Questions.

1. Describe the sources, and the upper portions of the courses, of the rivers rising in the Alps.

Illustrate your answer by a map, or by little sketch-maps, tracing each river till it reaches really level country.

Insert the lines of latitude and longitude.

The two largest rivers rising in the Alps are the Rhine and the Rhone. Other rivers are the Inn, a tributary of the Danube, the Ticino, tributary of Po, and the Aar, tributary of the Rhine.

The Rhine is formed by the union of the Vorder Rhine from a glacier on Mt. St. Gothard, and the Hinter Rhine from Vogelberg, 7000 feet above the sea. After this junction it flows north to the Lake Constance, and emerges at the northern extremity to take a westerly course. At Schafthausen it falls nearly 80 feet, and makes a still further descent of other 240 feet before it reaches Basel. It is at this place still 755 feet above the sea. Its volume is increased by the tributaries Neckar, Maine, Aar, Lippe, and Moselle. Near Mayence it passes through a mountain gorge, and then broadens into the slow stream of the Netherlands.

The Rhone also rises on St. Gothard. It drains the valley between the main chain of the Alps on the S. and the Bernese Alps on the N. It flows through the Lake Geneva after having fallen nearly 4000 feet from its source to the lake. Up to this point it has flowed in a westerly direction, but at Lyons it reaches a comparatively level country, and flows south into the Mediterranean.

2. Describe the physical character of Southern India.

N.B.—*Do not give a mere string of names, but try to give a clear general view of the country as a whole, introducing the important names as parts of your description.*

Southern India is triangular in shape, the apex pointing to the south. It may be said to be bounded on the north by the rivers Tapty and Mahanuddy. From the basins of these two rivers the land gradually rises till it reaches a height of 3000 feet. It then forms a great table-land, flanked by the Eastern and Western Ghauts, which meet together in the south, the united range going under the name of the Neilgherry Mountains. Between the Western Ghauts and the sea there is a fertile plain of about 40 miles in width. A similar plain but of greater breadth stretches between the Eastern Ghauts and the Bay of Bengal. The Western Ghauts are much higher than the Eastern Ghauts, and present an unbroken front to the coastward plain. Through gaps in the eastern chain, several rivers (Godavery, Kistnah, Pennair, and Cauvery) find their way to the sea. South of the Neilgherries is a great break, called the Gap of Coimbatore, beyond which the chain rises again and ends in the lofty Cape Comorin.

3. Supposing a vessel to be coming from Australasia to England, and to have brought articles of trade from each of the colonies; write an account of the whole cargo, describing where and how each part of it was procured.

Starting from Brisbane, the capital of Queensland, a vessel would bring wool, wine, cotton, and fruits from the great plains of that colony. Calling at Sydney it would add to its cargo, gold and copper, as well as more wine and wool. To these would be added, tallow and skins and more gold and wool at Melbourne.

South Australia is the best wheat-growing district, and the products of its fields, its flocks, and its vineyards would increase the lading of the ship at Geelong; while Tasmania would add whale oil and spermaceti from the great Antarctic seas. Oil and wood of different kinds as well as wool from Western Australia would complete the lading of the vessel.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.

Arithmetic.

MALES.

1. In a school of 80 scholars, open 10 half days a week, the average attendance is 72, but the average of the 70 most regular scholars is 68; how many half days on an average do the other 10 scholars attend?

Total No. of attendances $= 72 \times 10 = 720$
,, made by 70 reg. scholars $= 68 \times 10 = 680$
,, made by 10 irreg. scholars $= 40$
$\therefore$ Average attend. made by ditto $= 40 \div 10 = \underline{4}$. Ans.

2. At what rate per cent. per annum simple interest will £765 amount to £872 2s. in 4 years?

Int. for 4 yrs. $= £872\ 2s. - £765$
$= £107\ 2s.$
$\therefore$ Int. for 1 yr. $= £107\ 2s. \div 4$
$= £26\ 15s.\ 6d.$

$\therefore$ £765 : £100 :: £$26\frac{31}{40}$: Rate per cent.
$= \frac{1}{765} \times \frac{100}{1} \times \frac{1071}{40}$
$= \underline{34}$. Ans.

3. If a sovereign be worth 25 francs 15 centimes, what per cent. does a man lose in getting only 25 francs for a sovereign?

	c.
Loss on 25 fr. 15 c.	$= 15$
,, 1 ,,	$= \frac{15}{2515}$
,, 100 ,,	$= \frac{15 \times 100}{2515}$
	$= \frac{300}{503}$. Ans.

4. An army of 8000 men has rations for 25 days, but after 5 days it receives reinforcement, and the rations are consumed in 21 instead of 25 days; how many men were in the reinforcement?

If there had been no reinforcement the provisions would have lasted $25 - 5 = 20$ days.
They actually last $21 - 5 = 16$,, days

No. of men to eat provisions in 20 $= 8000$
,, ,, ,, 1 $= 8000 \times 20$
,, ,, ,, 16 $= \frac{8000 \times 20}{16}$
$= \underline{10{,}000 \text{ men.}}$

$\therefore$ Reinforcement $= 10{,}000 - 8000 = \underline{2000 \text{ men.}}$ Ans.

History.

MALES AND FEMALES.

1. Contrast the condition of the Norman and Saxon inhabitants of this country under William I. How long did this strife of races continue?

The Normans occupied all the places of trust and power. They were allowed to build castles, and overrun the country round about. These castles were a source of great trouble to the Saxons. The language of the courts of law and the church was Norman. The Normans despised their Saxon neighbours, treating them with great indignity. The Saxons were in most instances little better than serfs. They were treated with cruelty. Their clothing was coarse and contrasted very unfavourably with that of the Normans. They were forbidden under severe penalties to kill game, mutilation being the punishment. They were not permitted to assemble in numbers together. Their condition was in every way inferior to that of the Normans.

2. How did Henry II. gain the throne? Tell what you know about his wife.

Henry II. was the grandson of Henry I., at whose death the nobles promised fealty to Maud. This faith was broken by Stephen, grandson of the Conqueror, taking possession of the throne. Many attempts were made by Maud to gain possession of the throne, but with little success. Her son Henry, however, became Duke of Normandy, and came over to England to claim the throne. He gained some slight advantage over Stephen, but the nobles arranged a treaty, by which he was to become king after Stephen's death. By virtue of that treaty, he ascended the throne in 1154.

Henry married Eleanor, the divorced wife of Louis VII., of France. Their private life was unhappy. Henry had several natural children, and his wife is said to have poisoned 'Fair Rosamond,' one of his favourites.

3. Give the dates of our six kings styled Edward, and describe the character and fortunes of one of them.

Edward I., 1272-1307; II., 1307-1327; III., 1327-1377; IV., 1461-1483; V., 1483; VI., 1547-1553.

Edward the First was the greatest of the Plantagenet kings. He was energetic, industrious, and impartial. He carefully administered the laws, and made in them many improvements. He was proud and haughty, but confirmed the privileges of the people by renewing the Charter. His ambition led him to fight against both Wales and Scotland, treating his enemies with great cruelty. He began active life by fighting against the Saracens. Near Nazareth, he was shot by a poisoned arrow. On his father's death, he succeeded to the crown, took possession of Guienne, and almost immediately invaded Wales, which he subdued, making his son Prince of Wales.

The throne of Scotland was claimed by several persons, and Edward was asked to arbitrate between them. He claimed to be *overlord*, and gave the throne to Baliol. Baliol rebelled, and Edward invaded Scotland, defeating the Scots at Dunbar. After several Scotch victories under Wallace, Edward completed their overthrow at Falkirk; but while the affairs of Scotland were being considered in London, Bruce, now heir to the throne, drove the English from Scotland. On his way to punish Bruce, Edward died at Burgh-on-the-Sands, near Carlisle in 1307.

Teaching.

How may mental arithmetic be made interesting to young children?

In order to make mental arithmetic interesting to young children, it will be necessary that the questions which are asked should come well within their grasp, that they should appeal to their sympathies, and that they should deal almost absolutely with concrete subjects pertaining to their everyday life.

Questions about their play, their marbles, their games, the errands they run for their parents, the pages they read, the spellings they learn, and their home duties, always appeal to their feelings, and bright eyes invariably are seen where such questions are asked.

Taking places, where it can be done without noise or bustle, adds to the interest of a mental arithmetic lesson.

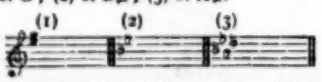
Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

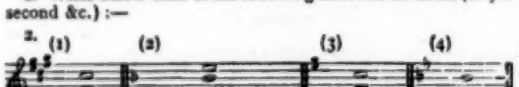
1. Write the key-signatures of each of the following major keys:—(1) of G; (2) of B♭; (3) of A♭.

1. (1) (2) (3)



2. Write below each of the following intervals its name (major second &c.):—

2. (1) (2) (3) (4)



Perfect 5th. Augmented 4th or Tritone. Imperfect 5th. Perfect 5th.

3. Add proper time-signatures to each of the following:—

(1) (2) (3)

3. (1) (2) (3)

TONIC SOL-FA NOTATION.

1. Write the names of the following intervals:—(1) *lah*, to *me*; (2) *fah* to *te*; (3) *te*, to *fah*; (4) *fah* to *doh'*.

1. (1) Perfect 5th; (2) Pluperfect 4th or Tritone; (3) Imperfect 5th; (4) Perfect 5th.

2. Which tones of the scale have the strongest leaning tendency?

2. *Te*; *fah*.

3. Write (1) a three-pulse measure; (2) a four-pulse measure; and (3) a six-pulse measure.

3

(1) | : : ‖ (2) | : | : ‖ (3) | : : | : : ‖

THIRD YEAR.

Pupil Teachers at end of Third Year.

FIRST PAPER.

Three hours and a half allowed.

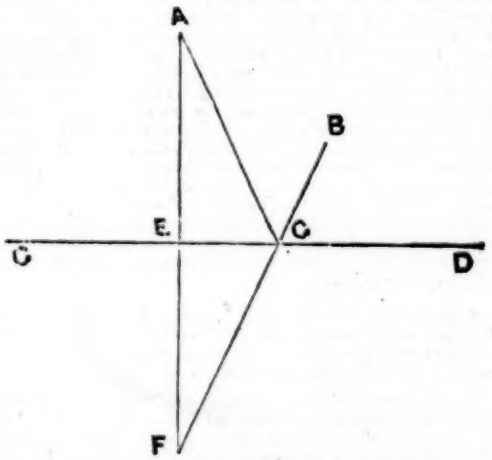
Euclid.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 1, *if you can.*

MALES.

1. From two given points on the same side of a given line, draw two lines which shall meet in that line and make equal angles with it.



Let A, B be the given points, and CD be the given line.

From A let fall AE perpendicular to CD, and produce AE to F, making EF = AE. Join F, B, cutting CD in G. Join A, G. AG and BG shall be the lines required.

Because AE, EG = FE, EG, and ∠ GEF = ∠ GEA (const.)

∴ ∠ AGE = ∠ FGE (I. 4.)

And ∠ EGF = ∠ BGD (I. 15)

∴ ∠ AGE = ∠ BGD. Q. E. F.

2. If two triangles have two sides of the one equal to two sides of the other, each to each, but the base of one greater than the base of the other; the angle contained by the sides of the one which has the greater base, shall be greater than the angle contained by the sides, equal to them, of the other.

Prop. 25, Bk. I.

3. To describe a parallelogram equal to a given rectilineal figure, and having an angle equal to a given rectilineal angle.

Prop. 45, Bk. I.

Algebra.

Answer two Questions.

1. If $a=5, b=7$, find the value of $6\sqrt{6(b^2-a^2)} - 7\sqrt[3]{12(a+b)^2}$;

also of $\dfrac{a^2-5ab+6b^2}{a-3b} - \dfrac{4(a^3-b^3)}{a^2+ab+b^2}$

(*a*) $6\sqrt{6(b^2-a^2)} - 7\sqrt[3]{12(a+b)^2}$

$=6\sqrt{6(49-25)} - 7\sqrt[3]{12(5+7)^2}$

$=6\sqrt{144} \quad -7\sqrt[3]{12^3}$

$=(6\times 12) \quad -(7\times 12)$

$= -12.$ Ans.

(*b*) $\dfrac{a^2-5ab+6b^2}{a-3b} - \dfrac{4(a^3-b^3)}{a^2+ab+b^2}$

$=\dfrac{(a-3b)(a-2b)}{a-3b} - \dfrac{4(a^2+ab+b^2)(a-b)}{a^2+ab+b^2}$

$=(a-2b) \quad -4(a-b)$

$=(5-14) \quad -4(5-7)$

$=-9+8$

$=-1.$ Ans.

2. What is the objection to the following?—Let $a=1$, then $a^2=1$ or $a^2-1=0$ ∴ (dividing by $a-1$) $a+1=0$ ∴ $a=-1$ ∴ $+1=-1$.

Solve the equation :—

$$\frac{x+1}{6}+\frac{3x-1}{8}-\frac{5x-7}{12}+1=\frac{7x-5}{24}$$

The objection lies in dividing by $a-1$. Since $a=1$ ∴ $a-1=0$. Hence the objection.

$$\frac{x+1}{6}+\frac{3x-1}{8}-\frac{5x-7}{12}+1=\frac{7x-5}{24}$$

Mult. by 24.

$4x+4+9x-3-10x+14+24=7x-5$;

Collecting, we have

$4x=44$

$x=11.$ Ans.

3. If $\dfrac{a}{b}=\dfrac{c}{d}$, show that $\dfrac{a+b}{a-b}=\dfrac{c+d}{c-d}$

Simplify $\dfrac{\dfrac{a}{b}+\dfrac{b}{a+b}}{a^2-ab+b^2-\dfrac{2b^3}{a+b}}$

(*a*) $\dfrac{a}{b}=\dfrac{c}{d}$ ∴ $\dfrac{a}{b}+1=\dfrac{c}{d}+1$

∴ $\dfrac{a+b}{b}=\dfrac{c+d}{d}$

$\dfrac{a}{b}=\dfrac{c}{d}$ ∴ $\dfrac{a}{b}-1=\dfrac{c}{d}-1$

∴ $\dfrac{a-b}{b}=\dfrac{c-d}{d}$

But $\dfrac{a+b}{b}=\dfrac{c+d}{d}$

∴ $\dfrac{\dfrac{a+b}{b}}{\dfrac{a-b}{b}}=\dfrac{\dfrac{c+d}{d}}{\dfrac{c-d}{d}}$

∴ $\dfrac{a+b}{a-b}=\dfrac{c+d}{c-d}$ Ans.

(*b*) Simplify $\dfrac{\dfrac{a}{b}+\dfrac{b}{a+b}}{a^2-ab+b^2-\dfrac{2b^3}{a+b}}$

$=\dfrac{\dfrac{a(a+b)+b^2}{b(a+b)}}{\dfrac{(a+b)(a^2-ab+b^2)-2b^3}{a+b}}$

$=\dfrac{\dfrac{a^2+ab+b^2}{b(a+b)}}{\dfrac{a^3+b^3-2b^3}{a+b}}$

$=\dfrac{\dfrac{a^2+ab+b^2}{b}}{\dfrac{a^3-b^3}{1}}$

$=\dfrac{1}{b(a-b)}$ Ans.

Mensuration.

A footpath goes along two adjacent sides of a rectangular field, 196 and 147 yards long. What distance would be saved if the path were made along the diagonal?

$\sqrt{(196)^2+(147)^2}$

$=\sqrt{38416+21609}$

$=\sqrt{60025}$

$=245$ Length of diagonal.

Distance saved $=(196+147)-245$

$=343-245$

$=98$ yards. Ans.

Arithmetic.

FEMALES.

1. Divide 6·817 by ·0017, and multiply the quotient by $\frac{1}{3}$ of ·00012525.

·0017)6·8170(4010·
68
·17
17
·0

$\frac{1}{3}$ of ·00012525
$=3\times$ ·00000501
$=$ ·00001503

4010· × ·00001503
$=$ ·0602703. Ans.

2. A person spends $\frac{1}{4}$ of his income on rent and taxes; ·35 on household expenses; and $\frac{1}{4}$ on other things. He has then £225 10s. 0d. saved every year; what is his annual income?

Fraction left $=1-(\frac{1}{4}+\cdot 35+\frac{1}{4})$

$=1-(\cdot 125+\cdot 35+\cdot 25)$

$=\cdot 275$

∴ ·275 : 1 :: £225·5 : Annual income.

$=$ £820. Ans.

3. A scuttle of coal is charged 2d. when coals are 27s. a ton; how much ought the scuttle to hold?

s. d. ton

27 : 2 :: 1 : x

∴ $x=2240\times 2\div 324$

$=13\frac{8}{81}$lbs. Ans.

4. Divide 100 into two parts, such that the one may exceed the other by 8·75.

Both Nos. are equal after 8·75 has been taken away.

∴ Lesser No. $\dfrac{100-8\cdot 75}{2}=45\cdot 625.$ Ans.

And greater No. $=45\cdot 625+8\cdot 75=54\cdot 375.$ Ans.

Grammar.

MALES AND FEMALES.

1. Every *one who* has *undertaken* to instruct others can *tell what* slow *advances* he has been *able* to make, and *how much* patience it requires to recall vagrant *inattention*, to stimulate sluggish indifference, and to rectify absurd misapprehension.

Analyse the above, parsing the words in italics.

2. Point out in this passage, (*a*) Latin prefixes. (*b*) English prefixes. (*c*) Latin affixes. (*d*) any English affix. (*e*) any double prefix.

3. Paraphrase the passage.

(1) ANALYSIS.

Sentence.	Kind.	Connective.	Subject.	Predicate.	Object.
(*a*)					
Every one can tell	Princ. Sent.		Every one	can tell	[Noun Sent.]
(*b*)					
Who has undertaken to instruct others	Adj. S. to *a*	In rel.	who	has undertaken	to instruct others
(*c*)					
What slow advances he has been able to make	Noun S. Obj. to *a*	In rel.	he	has been able to make what slow advances	
(*d*)					
And [he can tell]	Prin. S. co-ord. to *a*	and	[he]	[can tell]	
(*e*)					
How much patience it requires to recall vagrant inattention.	Noun S. to *d*	and	it, to recall vagrant inattention	requires	how much patience
(*f*)					
To stimulate sluggish indifference	Noun S. to *d*		To stimulate sluggish indifference	[requires]	[how much patience]
(*g*)					
And to rectify absurd misapprehension	Noun S. to *d*	and	to rectify absurd misapprehension	[requires]	[how much patience]

PARSING.

One—indef. pers. pro., masc. (or fem.), sing., 3rd, nom. to 'can tell.'
who—rel. pro., masc. (or fem.), sing., 3rd, nom. to 'has undertaken,' and agreeing with its antecedent 'who.'
undertaken—past part. of 'to undertake,' referring to 'who.'
tell—irreg. trans. verb, infin., pres., gov. by 'can,' forming with can, irreg. trans. verb, act., pot., pres., 3rd, sing., agreeing with its nom. 'one.'
what—rel. pro., used as adj., qual. 'advances.'
advances—com. noun, neut., plur., 3rd, obj., gov. by 'tell.'
able—adj. of quality, qualifying 'he.'
how—adv. of deg., qualifying 'much.'
much—adj. of quantity, qualifying 'patience.'
inattention—abs. noun, neut., sing., 3rd, obj., gov. by 'to recall.'

(2) Latin prefixes:— in-, ad-, at-, in-, dif-, ab-.
English ,, under-, mis-.
Latin affixes:— -tion, -ence, -sion, -ate.
English affix:— -ish.
Double prefixes:—inat- (L.), misap- (E. and L.), indif- (L.)

(3) All those persons who have attempted to teach others, are able to tell of the little progress they have been able to make, and what a great amount of endurance it needs in trying to refix the mind upon study after it has wandered, to rouse the slow and careless, and to put right ideas into the mind when once wrong ones have taken their place there.

4. What should you infer as to the origin of nouns which form their plural by a vowel change?

That the words were of Saxon origin. Many old English words formed their plurals by the addition of a syllable, which was nearly always accompanied by a change of the vowel sounds. In modern English the syllable has been lost, and the change of vowel sound remains.

Geography.

(Answer two Questions, including *one* map.)

1. Draw a full map, showing Burmah, Siam, and the islands of the Indian Archipelago.

N.B.—Insert the lines of latitude and longitude.

2. Describe the physical character of Southern India, giving a clear general view of the country, as a whole.

N.B.—*If you like*, instead of the map in Q. 1, you may draw a map in illustration of this answer. Insert the lines of latitude and longitude.

For answer to Question 2, refer to answer No. 2 in Second Year Questions in Geography.

3. What is an ocean current? Explain the causes of them, and give examples.

An ocean current is a movement of the waters of one part of the ocean to another. Currents depend primarily upon the unequal densities and temperatures of different parts of the ocean. Lighter waters ascend; colder waters descend, and where evaporation takes place, other waters flow towards that place to make up the deficiency. There is always a current setting in from the equator to the poles, and a counter current setting in from the poles to the equator. These two currents, however, are greatly modified in their direction by the configuration of the land, by the wind, and by other local causes. The principal currents of the Atlantic are the Equatorial and the Arctic, modified into the Gulf Stream, the Brazil, and the Guiana currents. In the Pacific, owing to its greater expanse, the currents are not so strongly marked, but there are, as in the Atlantic, the Equatorial and Polar Currents, with modifications of them in the Peruvian, New South Wales, Japan, and the counter currents.

In the Indian Ocean the Equatorial becomes the Mozambique current.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.

Arithmetic.

MALES.

1. Show that $\sqrt{\frac{(\cdot185)^2-(\cdot148)^2}{\cdot0175\times\cdot001575}}=21\frac{1}{7}$.

$$\sqrt{\frac{(\cdot185)^2-(\cdot148)^2}{\cdot0175\times\cdot001575}}=\sqrt{\frac{\cdot034225-\cdot021904}{\cdot0000275625}}$$
$$=\frac{\cdot111}{\cdot00525}$$
$$=21\cdot142857$$
$$=\underline{21\tfrac{1}{7}}.$$

2. If a grocer paid £10 6s. 3d. for $5\frac{1}{2}$ cwt. of sugar, how must he sell it per lb. to gain 12 per cent.?

$$\frac{£10\ 6s.\ 3d.}{5\frac{1}{2}\times112}=\frac{2475}{616}\text{ cost price per lb. in pence.}$$

As 100 : 112 :: $\frac{2475}{616}$: Selling price

$$=\frac{2475\times112}{616\times100}$$
$$=\underline{4\tfrac{1}{2}}\text{d. Ans.}$$

3. If the wages of men and boys are as 5 : 2, and 5 men and 4 boys earn £14 17s. in 12 days, find the wages of each per day.

Wages of 1 man $=\frac{1}{5}$ of a boy
,, ,, 5 men $=\frac{1}{5}\times5=2\frac{1}{5}$
,, ,, 5 men + 4 boys $=2\frac{1}{5}+4=16\frac{1}{5}$
∴ Wages of a boy per day $=\frac{£14\ 17s.}{16\frac{1}{5}\times12}$
$=1s.\ 6d.$
And ,, ,, man $=\frac{6}{5}$ of 1s. 6d.
$=\underline{3s.\ 9d.}$ Ans.

4. If I get £36 dividend from investing £1100 in $4\frac{1}{2}$ per cent. stock, what is the price of the stock? (Omit brokerage.)

£36 is obtained from £1100
1 ,, ,, $\frac{1100}{36}$
$4\frac{1}{2}$,, ,, $\frac{1100\times4\frac{1}{2}}{36}$
$=\underline{137\frac{1}{2}}$. Ans.

History.

MALES AND FEMALES.

1. Give in a table the names, dates, and relationship of our Stuart sovereigns from Mary of Scotland to Queen Anne.

Mary Queen of Scots.
|
James I. (1603-1625) son.
|
Charles I. (1625-1649) son.
|
Charles II. (1660-1685) son. James II. (1685-1688) brother.
|
Mary II. (1688-1694) daughter. Anne (1702-1714) sister.
marr. William III. (1688-1702) son-in-law.

2. What was the Long Parliament? Mention remarkable events attending its course and end.

The Long Parliament was a parliament called in 1639 by Charles I. for the purpose of raising money to continue the war against the Scots, who had rebelled against the introduction of the Liturgy into Scotland. It began its work by the impeachment of Strafford and Laud, and during its continuance the Courts of Star Chamber and High Commission were abolished, and the Grand Remonstrance to Charles was agreed upon; Charles broke its privileges by going to the House to seize some of its members, and the Civil War was determined upon and carried out by it. Those of its members who were opposed to the tactics of Cromwell were driven out, and eventually the remainder (the Rump) were driven out by Cromwell. It was recalled by the malcontent officers during Richard Cromwell's protectorate, but again dismissed. Then it was recalled by General Monk; and, after issuing writs for a new election, it dismissed itself after an existence of twenty years.

3. 'The social condition of England for the first few years of the peace of 1815 was wretched in the present and full of anxiety for the future.' Explain how the conclusion of a great war had such effects.

The National Debt of England was more than trebled by the war; and the whole of Europe was impoverished by it also. That being the case, there was no demand for British products abroad, and, consequently, little or no demand for labour at home. With a view of encouraging home trade and agriculture, the Corn Laws were passed, and this had the effect of raising the price of bread when there was less money to pay for it. The consequence was that large bands of workmen were unemployed. A scarcity of food occurred in 1816, and riots of different kinds took place in different parts of the country. Distress and discontent were rife, and political and other societies plotted revolution as well as demanded reforms. These events, while showing the wretchedness of the people in the present, augured ill for the happiness of the future.

Teaching.

Write out notes of a lesson on 'Mood.'

Introduction.—Write on blackboard any sentences showing the different uses of the same verb by means of inflexions or auxiliaries. From these sentences elicit the fact that *a verb may be used in several ways indicating a difference of meaning.*

The word used to show the mode in which the verb is used is '*Mood.*'

Definition.—To be written and committed to memory.—'Mood is that inflexion which a verb undergoes to show the mode or manner in which the action or state denoted by the action is presented to the mind.'

Kinds of Moods.—As far as possible get the distinction made by children of different kinds of statement. Some words declare positively (ex., I go). This form of verb is called the *Indicative Mood.* (Show meaning by giving Lat. root, *indico*, I point out.)

Another use of words is to *give commands.* This form is called the *Imperative Mood.* (Lat., *impero*, I command.) (Exs., Go; Come here.) The *Conditional* or *Subjunctive Mood* denotes uncertainty, doubt, or supposition. (Lat., *subjungo*, I subjoin.) (Ex., If I go.) Another form of the verb expresses ability, power, or permission to do a thing. This is sometimes called the *Potential Mood.* (Ex., I may go.) The form of the verb in which no limitation of the idea of doing is stated is called the *Infinitive Mood.* (*Infinitus*, unbounded.) (Ex., To go.)

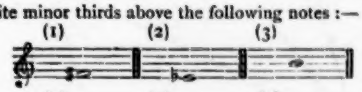
[NOTE.—The above contains matter for a long lesson on Mood, a great number of examples being needed to impress the points thoroughly upon the minds of the children.]

Music.

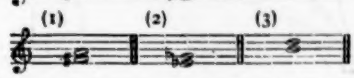
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both.* The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write minor thirds above the following notes:—

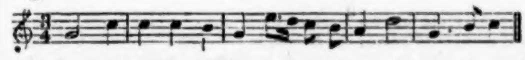


1.



2. Add bars in their proper places to the following:—

2.



3. State (briefly) the meanings of the following:—(1) M. 90; (2) *Staccato*; (3) 𝄐.

3. (1) The Metronome is to be set so as to beat 90 per minute; (2) a term used when notes are to be sung short; (3) the Hold—notes over which it is placed are to be held longer than usual.

TONIC SOL-FA NOTATION.

1. Write minor thirds above the following notes:—(1) *soh*; (2) *doh*; (3) te_1.

1. (1) *Soh, ta*; (2) *doh, ma*; (3) te_1, *ray.*

2. Re-write the following in two-pulse measure, halving the value of each note:—

|m :— |s.l :f |r :d.t_1|f :m ‖

2. |m :s,l.f |r .d,t_1:f .m ‖

3. State (briefly) the meanings of the following:—(1) M. 90; (2) *Staccato*; (3) 𝄐.

3. (1) That the Metronome is to be set so as to make 90 beats per minute; (2) that the notes over which the sign for which the word stands is placed, are to be sung short; (3) the Hold—it shows that the note above which it is placed must be held longer than usual.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year.

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including No. 1, if you can.

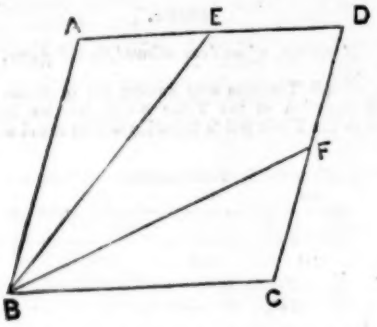
1. A point is taken in each of two adjacent sides of a parallelogram at the same distance from the angle in which they intersect; show that if these points be equally distant from the opposite angle, the parallelogram is a rhombus.

Let ABCD be a parallelogram, and let DE=DF, and EB=FB; then ABCD is a rhombus. Join BD.

Because BE, ED=BF, FD each to each, and base BD is common, ∴ ∠BED=∠BFD (I. 8).

And ∠'s DEB, BEA = ∠'s BFD, BFC (I. 13).

∴ ∠ BEA = ∠ BFC. And opposite ∠'s BAE, BCF are equal (Def.).



∴ ∠'s BEA, BAE = ∠'s BFC, BCF; and side BE = side BF,
∴ (I. 26) BA = BC.
But BA = DC, and BC = AD (Def.)
∴ All sides are equal, and ABCD is a rhombus. Q. E. D.

2. If there be two straight lines, one of which is divided into any number of parts; the rectangle contained by the two straight lines, is equal to the rectangles contained by the undivided line, and the several parts of the divided line.

Give the corresponding formula in Algebra.

Prop. 1, Bk. II.

Let A and BC be the two lines, and BD, DE, and EC the parts of BC.
Let A = a, and BC = b, and BD, DE, EC = x, y, z.
Then $ab = ax + ay + az$.

3. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts may be equal to the square on the other part.

Prop. 11, Bk. II.

Algebra.

Answer two Questions.

1. What fraction is equivalent to the mixed expression :—

$$x^3 + xy + y^2 + \frac{x^2y + y^3}{x - y}$$

Find its value when $x = -\frac{2}{3}$, $y = 1\frac{1}{2}$.

(*a*)
$$x^3 + xy + y^2 + \frac{x^2y + y^3}{x - y}$$
$$= \frac{(x - y)(x^2 + xy + y^2) + x^2y + y^3}{x - y}$$
$$= \frac{x^3 + x^2y}{x - y}$$
$$= \frac{x^2(x + y)}{x - y} \quad \text{Ans.}$$

(*b*)
$$x = -\tfrac{2}{3},\ y = 1\tfrac{1}{2}$$
$$\therefore \frac{x^2(x + y)}{x - y}$$
$$= \frac{\frac{4}{9}(1\frac{1}{2} - \frac{2}{3})}{-\frac{2}{3} - 1\frac{1}{2}}$$
$$= \frac{\frac{4}{9} \times \frac{5}{6}}{-4\frac{1}{6}}$$
$$= \frac{\frac{2}{9}}{-4\frac{1}{6}}$$
$$= -\frac{2}{39}. \quad \text{Ans.}$$

2. Solve the equations :—

(1) $91x - 68y = 4{\cdot}7$
$84x - 51y = 11{\cdot}4$

(2) $\cdot 07x^2 - \cdot 625x + 1{\cdot}245 = 0$

and form the equation whose roots are -7, $\frac{5}{2}$.

(1) $91x - 68y = 4{\cdot}7$ (1)
$84x - 51y = 11{\cdot}4$ (2)
Mult. (2) by 4 $336x - 204y = 45\ 6$
(1) by 3 $273x - 204y = 14{\cdot}1$
Subtracting $63x = 31{\cdot}5$
and $x = \underline{{\cdot}5}$. Ans.

Substituting value of x in (1)
$45{\cdot}5 - 68y = 4{\cdot}7$
$-68y = -40{\cdot}8$
and $y = \underline{{\cdot}6}$. Ans.

(2) $\cdot 07x^2 - \cdot 625x + 1{\cdot}245 = 0$
$\therefore 70x^2 - 625x = -1245$
and $x^2 - \frac{625x}{70} x = -17\frac{45}{70}$

Completing the square—
$$x^2 - \tfrac{625}{70}x + (\tfrac{625}{140})^2 = -17\tfrac{45}{70} + (\tfrac{625}{140})^2$$
$$\therefore x - \tfrac{625}{140} = \pm\tfrac{325}{140}$$
and $x = \frac{625}{140} \pm \frac{325}{140}$
$= \underline{5\frac{1}{7} \text{ or } 3}$. Ans.

$$(x + 7)(x - \tfrac{3}{5}) = 0$$
$$= x^2 - \frac{3x}{5} + 7x - \tfrac{21}{5} = 0$$
$$= \underline{5x^2 + 32x = 21}. \quad \text{Ans.}$$

3. A coach leaves a town travelling $6\frac{1}{2}$ miles per hour; 12 hours afterwards a courier who travels $8\frac{1}{3}$ miles an hour is sent after it. In what time will he overtake the coach?

Let x = time required in hours.
$8\frac{1}{3}x = 6\frac{1}{2}(x + 12)$
$52x = 39x + 468$
$\therefore 13x = 468$
and $x = \underline{36 \text{ hours}}$. Ans.

Mensuration.

An equilateral triangle and a circle have the same perimeters; compare their areas.

Suppose one side of triangle = 2 ∴ Perimeter = 6
∴ area of triangle = $\sqrt{3(1 \times 1 \times 1)} = \sqrt{3} = \underline{1{\cdot}732}$
Perimeter of circle = 6 ∴ Radius = $\frac{1}{2}(6 \div 3\frac{1}{7})$
$= \frac{21}{22}$

Area of circle = $3\frac{1}{7}$ Radius^2
$= \frac{22}{7} (\frac{21}{22})^2$
$= \frac{63}{44}$

Area of triangle : Area of circle :: $1{\cdot}732 : \frac{63}{44}$
$= \underline{38{\cdot}104 : 63}$. Ans.

Arithmetic.

FEMALES.

1. I placed £325 in the bank on 10th of January, 1883, and withdrew principal and interest on 5th June. What amount did I withdraw, supposing that the bank paid $3\frac{1}{2}$ per cent.?

From 10th January, 1883, to 5th June = 146 days;
Int. on £325 for 146 days at $3\frac{1}{2}$ per cent.
$$= \frac{325 \times 3\frac{1}{2} \times 146}{100 \times 365} = £4\ 11s.$$
Amount withdrawn = £325 + £4 11s. = £329 11s. Ans.

2. Divide £224 12s. into parts in the ratio of $\frac{1}{2}$, $1\frac{1}{2}$, and 2.

No. of parts = $\frac{1}{2}$, $1\frac{1}{2}$, 2; or 1, 3, 4 = 8
Divisions = $\frac{1}{8}$ of £224 12s. = £28 1s. 6d. Ans.

$\frac{3}{8}$,, = £84 4s. 6d. Ans.

$\frac{4}{8}$,, = £112 6s. 0d. Ans.

3. How much less shall I receive annually by investing £5,795 in 3 per cents at 95, than if I had placed the same amount in 5 per cents. at 105?

Income from 1st investment = $\frac{5795 \times 3}{95} = £183\frac{3}{19}$.

Income from 2nd investment = $\frac{5795 \times 5}{105} = £275\frac{10}{21}$.

Less amount received = $£275\frac{10}{21} - £183\frac{3}{19} = £92\frac{11}{21}$. Ans.

4. A pays £9 3s. 4d. more rates than B, their incomes being equal. Residing in different towns, they are rated at 2s. and 1s. 4d. in the £ respectively. Find the income of each.

Difference of rating per £ = 2s. − 1s. 4d. = 8d.
For every 8d. contained in £9 3s. 4d. they receive £1 income.
∴ Amount of income = 2200 ÷ 8 = £275. Ans.

Grammar.

MALES AND FEMALES.

1. Learning hath *his* infancy, when *it* is *but* beginning and almost childish: then his *youth*, when it is luxuriant and juvenile: *then* his strength of years, when it is solid and *reduced*: and, lastly, his old age, when it *waxeth* dry and *exhaust*. *But* it is not good to look too long upon these *turning* wheels of vicissitude, *lest* we *become* giddy.—BACON.

Analyse this passage down to the word 'exhaust,' and parse the words in italics.

2. Comment on the use of the pronoun 'his' in it, and mention any similar use of it in another passage.

3. Point out any words in the above which have a Latin root.

(1) ANALYSIS.

Sentence.	Kind.	Connective.	Subject.	Predicate.	Object.	Extension.
(*a*) Learning hath his infancy	Princ. Sent.		Learning	hath	his infancy	
(*b*) when it is but beginning	Adj. to *a*	when	it	is but beginning		
(*c*) and almost childish	Adj. to *a*	and	[it]	[is] almost childish		
(*d*) then his youth	P. S. coord. to *a*		[it]	[hath]	his youth	then
(*e*) when it is luxuriant and juvenile	Adj. to *d*	when	it	is luxuriant and juvenile		
(*f*) then his strength of years	P. S. coord. to *a*, *d*		[it]	[hath]	his strength of years	then
(*g*) when it is solid and reduced	Adj. to *f*	when	it	is solid and reduced		
(*h*) and, lastly, his old age	P. S. coord. to *a*, *d*, *f*	and	[it]	[hath]	his old age	lastly
(*i*) when it waxeth dry and exhaust	Adj. to *h*	when	it	waxeth dry and exhaust		

PARSING.

His—pers. pro., neut. (masc. form) sing., 3rd., poss., gov. by 'infancy.'
it—per. pro., neut., sing., 3rd., nom. to 'is beginning.'
but—adv. of deg., mod. 'is beginning.'
youth—abs. noun, neut., sing., 3rd., obj., gov. by 'hath,' und.
then—adv. of time, mod. 'hath.'
reduced—adj. of quality, qual. 'learning.'
waxeth—verb, reg. int., act., ind., pres., sing., 3rd, agreeing with 'it.'
exhaust—adj. of quality, qual. 'learning.'
but—conj., disj., introducing the sentence 'it is not good,' and used correlatively with 'lest.'
turning—pres. participle, used as adj., qual. 'wheels.'
lest—conj., disj., joining the sentences 'it is not good' and 'we become giddy.'
become—irr. intrans. verb, act., ind., pres., sing., agreeing with 'we.'

(2) In Old English the word *his*, a true possessive from *he*, was used indiscriminately for both masculine and neuter genders. It is so used in the passage above. Other examples:—

The tree yielding seed after *his* kind.
If the salt have lost *his* savour.

(3) Infancy, luxuriant, juvenile, solid, reduced, exhaust, vicissitude.

4. Mention any great writers in the eighteenth century and their works.

Alexander Pope (Rape of the Lock, Iliad, Odyssey, Essay on Man), James Thomson (Seasons, Castle of Indolence), poets; Addison and Steele (Spectator, Tatler, etc.), essayists; Hume and Robertson, historians; Dr. Johnson (Dictionary, Lives of Poets, and Rasselas); Adam Smith (Wealth of Nations), economist; Goldsmith (Vicar of Wakefield, Traveller, Deserted Village), poet and novelist; Burns (Songs); Burke (Essays, History of Revolution), statesman, etc.

Geography.

(*Answer two Questions, including Question* 1.)

1. Give 'Notes of a Lesson' on 'The Arrangement of Land and Water on the face of the Earth.' Illustrate by a map.

Introduction.—Show map of world in hemispheres, eastern and western, also land and water hemispheres if possible, and use globe.

Unequal distribution of land and water.—Most land in northern hemisphere, and in temperate zone least in arctic and torrid zones.

Most water in southern hemisphere, and in torrid zone.

Effects of this distribution.—Land made more serviceable for man. He is fitted for temperate climate, cannot do with excess of heat or cold; this distribution a wise provision.

Most water where evaporation can take place easiest. Earth thus supplied with clouds, moisture, rain, etc. Distribution such as to provide best for movements of water, preventing stagnation and putridity.

Benefits derived from this distribution.—Parts man inhabits more accessible, seas enabling him to reach every part easily; provided with vegetable products better than by any other method.

2. Say what you know about Mexico, Guatemala, Cotopaxi, Quito, Lima, Terra del Fuego, Juan Fernandez. Describe each as fully as you can.

Mexico.—A country of N. America, bounded by the United States on the N., W. by Pacific, S. by Central America, and E. by Gulf of Mexico. 1300 miles long, 140 to 700 miles broad in the N. Area, 742,000 sq. miles. Consists of large plateau or table-land, varying from 6000 to 8000 feet in height. Climate, mild and genial, except on low coasts, where it is hot and unhealthy. Soil, fertile. Wild cattle and cochineal insect found in large numbers. Minerals abundant. Capital, same name; 230,000 inhabitants.

Guatemala.—Largest state in C. America, extending from Yucatan to Pacific, and is bounded by Mexico on W., and by Honduras on E. Surface, mountainous, but soil productive. Cochineal and indigo exported in large quantities. Volcanoes numerous, and earthquakes common. Cap. Guatemala, 45,000.

Cotopaxi.—A volcanic mountain of Ecuador, S. America, 34 miles south of Quito. Its shape is conical, rising 19,500 feet above the level of the sea. It is the highest active volcano in America.

Quito.—Situated in a ravine on the E. of the volcano Pichincha, 9543 feet above the sea. Situation delightful, enjoys a perpetual spring climate, while it has within view many peaks covered with perpetual snow. Earthquakes are common, yet it has a pop. of 76,000, and its trade is large in grain and other agricultural produce.

Lima.—Cap. of Peru, on the Rimac. Finest city in S. America. Houses of one storey, owing to earthquakes. Large trade through Callao, its port; university, the oldest in America.

Terra del Fuego.—A group of islands at the south of S. America, separated from mainland by Straits of Magellan. Consists almost entirely of barren rocks, inhabited only by penguins and sea-fowl.

Juan Fernandez.—An island in the Pacific Ocean, 400 miles W. of Chili. 18 miles long and 6 broad. Named after the Spanish navigator by whom it was discovered in 1567. Alexander Selkirk lived on it four years about 1700. De Foe's *Robinson Crusoe* is founded on this event.

3. What are the causes of the tides? Describe the tide in the Bay of Fundy, and say where, in Great Britain, specially strong tides can be seen.

The tides are the movements of the waters of the earth, caused by the attraction of the sun and moon. In its progress round the world, the moon attracts the waters of the earth, which being

free to move follow the moon in its course. The attraction of the sun is of a similar kind, but of less force because of its distance from the earth.

As the tidal wave crosses the Atlantic, it is impeded in its course by the continent of America. The wave is therefore deflected, and the Bay of Fundy becoming narrower, as it goes further inland the volume of water becomes narrowed, and therefore increased in depth. It rushes up with great force and often reaches a height of from 70 to 100 feet. Its ebb is as rapid as its flow.

The tidal wave passing up the British Channel is narrowed in a similar manner, and the tides in that part of the British Isles are of the same character, but as the volume of the tidal wave is not so great, the tides are not so high. In each of the narrow inlets on the W. coast of Great Britain, a similar appearance is seen, but much less in extent.

SECOND PAPER.

Two hours and a half allowed.

Needlework.

FEMALES.

The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.

Arithmetic.

MALES.

1. Define a fraction. Explain what is meant by multiplying $\frac{3}{4}$ by $\frac{1}{5}$, and show why $\frac{3}{4} = \frac{15}{20}$.

A fraction is a part or parts of a unit. It is expressed by two numbers, one above the other with a line between them, the lower number being called the denominator, and showing into how many parts the unit is divided, and the upper number being called the numerator, and showing how many of such parts are taken to form the fraction.

Multiplying $\frac{3}{4}$ by $\frac{1}{5}$ means that the fraction $\frac{3}{4}$ has first to be multiplied by 5, thus becoming $\frac{15}{4}$. This number, however, is 7 times too great, and $\frac{15}{4}$ has therefore to be divided by 7. As 15 cannot be divided by 7 without a remainder, the denominator is multiplied by 7, and each of $\frac{15}{4}$ becomes $\frac{1}{7}$ the part of what it was before, viz., $\frac{1}{28}$, and the result obtained is $\frac{15}{28}$.

A line 15 inches long can be divided into parts of 1 inch each, the inch being $\frac{1}{15}$ of the whole. $\frac{1}{15}$ would be 6 inches. The same line could be divided into 5 parts, each part being 3 inches long. 2 of such parts ($\frac{2}{5}$) would = 6 inches. It is thus seen that $\frac{2}{5}$ of the line = $\frac{1}{15}$ of the same line.

The same reasoning would apply to abstract quantities.

2. Find how many yards of carpet, 27 inches wide, will cover a room 24 feet 6 in. long by 18 feet wide; and its cost at 4s. 6d. a yard.

$$\text{Length of carpet in yards} = \frac{24\frac{1}{2} \times 18}{2\frac{1}{4} \times 3} = \frac{49}{2} \times \frac{18}{9} \times \frac{4}{3} = 65\frac{1}{3} \text{ yards.} \quad \text{Ans.}$$

$$\text{Cost} = 4\tfrac{1}{2}\text{s.} \times 65\tfrac{1}{3} = \tfrac{9}{2} \times \tfrac{196}{3}\text{s} = 294 = \underline{£14\ 14\text{s.}} \quad \text{Ans.}$$

3. What change is made in a man's income by his transferring £11,000 from the 3 per cents. at 101$\frac{1}{2}$ into 4$\frac{1}{2}$ per cent. debentures at 137$\frac{1}{2}$, the usual brokerage being charged on each transaction?

$$\text{First income} = \frac{11000 \times 3}{100} = \underline{£330}$$

$$\text{Proceeds of sale} = \frac{11000 \times (101\frac{1}{2} - \frac{1}{2})}{100} = £11137\tfrac{1}{2}$$

$$\text{Second income} = \frac{11137\frac{1}{2} \times 4\frac{1}{2}}{137\frac{1}{2} + \frac{1}{2}} = \underline{£364\ 10\text{s.}}$$

$$\text{Change made} = £364\ 10\text{s.} - £330 = \underline{£34\ 10\text{s. gain.}} \quad \text{Ans.}$$

4. The sum of £15 10s. is to be divided amongst 3 men, 5 women, and 8 boys, so that for every shilling a man gets a woman gets 8d. and a boy 6d. Find the share of each.

		s.
The men will get	$12 \times 3 =$	36
while the women	$8 \times 5 =$	40
and the boys	$6 \times 8 =$	48
		124

Each man will get $\frac{1}{3}$ of $\frac{36}{124}$ of 310 = $\underline{30\text{s.}}$ Ans.
" woman " $\frac{1}{5}$ of $\frac{40}{124}$ of 310 = $\underline{20\text{s.}}$ Ans.
" boy " $\frac{1}{8}$ of $\frac{48}{124}$ of 310 = $\underline{15\text{s.}}$ Ans.

History.

MALES AND FEMALES.

1. Give some evidence of the growing power of the House of Commons under James I.

The first Parliament of James I. framed an 'Apology,' showing that they held their privileges 'by right and not by grace.' The second Parliament declined to grant supplies till illegal impositions and other grievances were redressed. They were dismissed because of this, but when the third Parliament was called, the same spirit showed itself. Monopolies were attacked, their authors impeached, and the venality of Lord Bacon punished. One of their number was imprisoned, and a petition was presented to the king. Then came the protestation in which they declared that their privileges were the undoubted birthright of the people of England. This was the real beginning of the contest between king and people for the supreme power in the country. It ended in the dethronement of the Stuarts.

2. What part did England take in the war of the Spanish succession? And why?

England joined the Grand Alliance against France, and the campaigns in which the battles of Blenheim, Ramilies, Almanza, Oudenarde, and Malplaquet, were fought, were joined in by the English, under Marlborough. Gibraltar was also taken by Sir George Rooke, while the Earl of Peterborough was successful in Spain.

Great fears were entertained respecting the growing power of France and her claims to the Spanish throne rendered vacant by the death of Charles in 1700. To prevent the excess of power, the Spanish dominions had been partitioned in treaties among the rival claimants, to which work France had assented, but in despite of this, the French king accepted for his grandson the whole of the Spanish dominions, and also supported the claims of the Pretender to the English throne. William desired to take such steps, and the nation wished it also, as would punish him for his perfidy, cause reparation to be made for the insult to this country, and prevent this access of power. These reasons led to the war of the Spanish succession.

3. 'Of a Spanish invasion,' said Lord Chatham in his last speech, 'of a French invasion, of a Dutch invasion, many noble lords may have read in history; and some lords,' here he looked keenly at Lord Mansfield, 'may perhaps remember a Scotch invasion.' Describe, with dates, the invasions of England alluded to in this extract.

The Spanish invasion was attempted by Philip II. of Spain, in 1588. A great fleet was prepared, and an army ready in the neighbourhood of Dunkirk. The English fleet, however, succeeded in destroying a large proportion of the ships, and no landing was ever effected. A small proportion of the ships reached Spain.

Louis II., the eldest son of the king of France, landed in England in 1216 for the purpose of driving John from the throne. Many of the barons joined him, but grew jealous when they saw him offer lands and castles to his friends. After John's death, two battles were fought, one in Lincoln and the other on the sea, in which Louis was defeated. He then made peace and went home.

In 1666, the Dutch fought against England, and in 1667, a fleet sailed up the Medway, burned the ships at Chatham, and blockaded the river Thames. Evelyn's diary records the pain with which he noted the dishonour thus done to his country, a disgrace never to be wiped off.

The Young Pretender in 1745 tried to regain the throne for the Stuarts. He landed at Inverness, fought the battle of Prestonpans, evaded the Duke of Cumberland, marching southwards as far as Derby, and causing a great panic in the country. Being inadequately supported by the English, he retraced his steps, and was defeated at Culloden.

Teaching.

Write out notes of a lesson on 'Good Manners.'

Introduce the lesson by speaking of the motto on one of the great schools of the country, 'Manners make the man.' Then xplain what is meant and included in the word 'Manners.'

Manners of two kinds.—Good and bad. How boys are distinguished from each other: By their actions, behaviour, mode of speech, their conduct towards all who come near them.

Distinguishing features.—Good: calm, gentle, and respectful in speech. In actions—kind and friendly towards equals; obedient towards superiors; helpful towards all in need. Respect shown to the feelings of others.

Bad: Exactly opposite to above; rough and rude in speech, disrespectful, unkindly, disobedient, harmful, inconsiderate in action.

Effect of different manners.—Producing a pleasant, agreeable feeling and sympathy if good, otherwise if bad. Company sought of those who have good manners. Shunned if bad. Success likely to follow the lad with good manners.

Give examples of different effects produced by different manners, with illustrations from personal experience if possible.

Music.

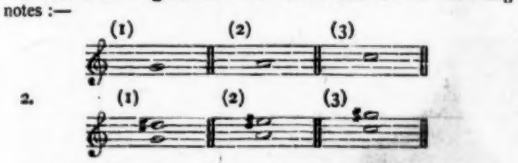
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

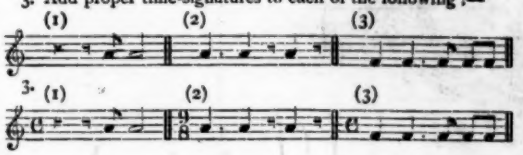
1. Write in the Treble clef the signature and the ascending scale of G minor, using the major or sharp sixth, and the sharp seventh.

1.

2. Write an augmented fifth above each of the following notes:—



3. Add proper time-signatures to each of the following:—



TONIC SOL-FA NOTATION.

1. Write an augmented fifth above each of the following notes:—(1) *fah*; (2) *doh*; (3) *ray*.

1. (1) *fah, de*^{1}; (2) *doh, se*; (3) *ray, le*.

2. Write the minor scale (*lah* mode), using the minor or flat sixth, and the major or sharp seventh.

2. l, t, d r m f se l

3. Write the following in six-pulse measure by trebling the value of every note:—

3. |s ,- ,l :s ,f ,r |m :d ‖

|s :—:l |s :f :r |m :—:—|d :—:—‖

Messrs. Griffith and Farran will shortly publish a set of Test Cards in Arithmetic, printed as Duplex Cards, with Mental Arithmetic exercises on one side and Arithmetic for the Standards on the other. They will be strictly based on Schedule I of the Code of Regulations just issued by the Education Department and on the published instructions to Inspectors.

As these Cards will be precisely similar to questions set at the Government Examinations, Teachers using them will have a reliable means of gauging the condition of their schools at any preliminary test examination they may hold.

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'SCHOLAR' FOR MAY, 1884.

STANDARD III.

(1) 4085.
(2) 14+1694.
(3) 1450+173.
(4) 2454+6.
(5) £1229 9s. 3$\frac{3}{4}$d.
(6) £2901 9s. 5$\frac{1}{4}$d.
(7) £4066 8s. 7d.
(8) £4288 10s. 7d.
(9) £2949 4s. 10$\frac{3}{4}$d.
(10) £3985 10s. 4$\frac{1}{2}$d.
(11) £3287 14s. 0$\frac{1}{4}$d.
(12) £66 14s. 9d.

STANDARD IV.

(1) £13776 5s. 4$\frac{1}{2}$d.
(2) £264,645 5s. 10d.
(3) £1256 14s. 11$\frac{1}{4}$d. +70.
(4) £78 14s. 10$\frac{3}{4}$d.
(5) £306 17s. 8$\frac{3}{4}$d.
(6) 76 tons 14 cwt. 2 qrs. 21 lbs. 1 oz.
(7) 1,085,440 drams.
(8) £706 13s. 4d.
(9) 1833 stones 5 lbs. 11 oz.
(10) £40.
(11) £30 7s. 4d.
(12) £13 15s.

STANDARD V.

(1) £606,479 17s. 1d.
(2) 60 yards.
(3) Calico, £1 19s.; cloth, 12s. 3d.; merino, £17 1s. 2$\frac{1}{2}$d.; silk, £86; total, £105 12s. 5$\frac{1}{2}$d.
(4) One-fifth.
(5) £4911 0s. 6d.
(6) £39 8s. 1$\frac{1}{2}$d.
(7) £1125.
(8) £13 16s. 8d.
(9) £128 3s. 5$\frac{1}{2}$d.
(10) £7 17s. 1$\frac{3}{4}$d.
(11) 24 oz.
(12) $\frac{101}{132}$.

STANDARD VI.

(1) £28 7s.
(2) $\frac{3004}{3125}$.
(3) £7 8s. 10$\frac{1}{2}$d.
(4) 46·55165.
(5) £33 13s. 3$\frac{3}{4}$d.
(6) £25.
(7) £1 8s. and 14s.
(8) 8·72 persons.
(9) £3 14s. 9·2d.
(10) $\frac{5}{6}$.
(11) 542·1875
(12) 21·428 days.

STANDARD VII.

(1) 104$\frac{1}{2}\frac{1}{3}$.
(2) 1s. 10$\frac{1}{2}$d.
(3) £120 5s. 11$\frac{80}{101}$d.
(4) £31.

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'LITTLE LEARNER' FOR MAY, 1884.

STANDARD I.

(1) 2446
(2) 641
(3) 95
(4) 2723
(5) 341
(6) 64
(7) 3456
(8) 666
(9) 87
(10) 2369
(11) 3731
(12) 1684
(13) 2357
(14) 189
(15) 2173
(16) 389

STANDARD II.

(1) 40,189
(2) 11,899
(3) 21,175,703
(4) 39,173,730
(5) 7172+5
(6) 3904+3
(7) 4,672,580
(8) 4,923,644
(9) 32,669
(10) 10,676
(11) 1089+6
(12) 63,611
(13) 50,529,339
(14) 9845+4
(15) 52,973
(16) 4922+10
(17) 5,482,070
(18) 4687
(19) 26,602
(20) 2843+2

Owing to pressure on our space, the continuation of Dr. Coupland's 'Discipline of the Mind' is unavoidably held over.

Mr. Richard Greenwood,

President of the National Union of Elementary Teachers.

THE conference of the National Union of Elementary Teachers, recently held at Leicester, derived no small part of its success from the able and comprehensive address delivered by the new President, Mr. Richard Greenwood. It is, therefore, not inappropriate to give our readers a sketch of Mr. Greenwood's career.

Mr. Greenwood is a native of Cornwall, and is now forty-six years of age, having been born in Truro in the year 1838. At the age of thirteen, he became a pupil teacher in the Central Schools of his native town. At the close of his apprenticeship, he took a good position on the list of First-class Queen's Scholars, and entered the Exeter Training College, where he remained for a period of two years and a quarter. During his residence in college, he distinguished himself not only by carrying off many of the college prizes, but also by winning the regard and esteem of his tutors and fellow-students. His geniality of disposition, his devotion to duty, and his almost stern adhesion to whatever he considered a matter of conscience or of principle, gained for him at this stage of his career the respect and confidence of all who came in contact with him. At the close of his college course he was appointed to the Mastership of the National School (mixed) of Kilkhampton, a pleasant but retired village of North Cornwall, where he is remembered with pride and affection by his former pupils. Here Mr. Greenwood laboured for a period of twelve years, and here he must have acquired that knowledge of the special difficulties and circumstances of country schools, which is evidenced in his presidential address. Earnest, practical, and high-principled, he exercised a wholesome and manly influence over the young people of Kilkhampton, and was regarded by the Rev. Canon Thynne, the Rector, as a personal friend and fellow-worker. In 1867 Mr. Greenwood's certificate was raised to the 'First-class,' and in the report of the Education Department for 1869-70, his school is mentioned as 'one of the best in the county.' From Kilkhampton, Mr. Greenwood removed in 1871 to the Parochial (Endowed) School of St. Saviour, Southwark, a change of the most complete character. Here, too, success attended his indefatigable efforts. The school became one of the most popular and successful in South London, and during the three years of Mr. Greenwood's mastership, largely increased both in numbers and efficiency. In 1874 the Inspector for the district strongly recommended Mr. Greenwood to the London School Board, and in July of that year, he was appointed Head-master of the Board School, Jamaica Level, Bermondsey (now known as the Southwark Park Board School), a post he still occupies. The successive reports of the Inspectors show that the work done in this school is of a thorough and sterling kind. One of the early reports states, that 'This school is becoming one of the very best under my inspection. In each department the classes are well arranged, the teaching power judiciously distributed, and sound methods of instruction employed. The children work with neatness, accuracy, and despatch. Order and discipline are good, and a nice tone pervades every part of the school.' Mr. Greenwood has not confined his teaching to the 'bare bones of the rudiments.' In 1877, one of his scholars carried off the Mortimer Memorial Scholarship, and in 1878,

another headed the list, taking a Clothworkers' Scholarship. In 1879, his pupils gained three of the five open scholarships at St. Olave's Grammar School, Southwark, and in 1880, two others were equally successful. The total value of the scholarships gained by scholars from the Southwark Park Board School now amounts to more than £1,000. Such a record of professional success is worthy of the President of the National Union. Mr. Greenwood is a strong advocate of Physical Education, and, as an enthusiastic cricketer, has himself done something by his example for its extension. Amidst the pressure of his scholastic duties, Mr. Greenwood has found time to take part in many educational and professional movements. For many years he has been an active member of the Committee of Church Teachers' Benevolent Institution, of which he was one of the founders. Shortly after removing to London he became the first Secretary of the Southwark Teachers' Association, a post he held for six years, and in 1874 he was elected a member of the Executive of the National Union. In 1875 and 1876 he devoted much attention to the establishment of the Teachers' Provident Society, and became the first Chairman of its General Board of Management. He was also Chairman of the Committee which drew up the Schemes for the Teachers' Benevolent and Orphanage Funds. In 1878 he was elected General Treasurer of the Union, a post he held for five years, until in 1883 he was elected Vice-President. At the Conference just held he was inducted into the presidential chair by his predecessor, Mr. Dawson, B.A., who in introducing him said, 'From the time and attention, the trouble and zeal that he has devoted in the past to the work of the Union, in ascertaining the needs of teachers, and in trying to get them satisfied, and from the great ability that he can bring to bear upon different subjects, I am quite sure he will fully maintain the honour of the Union and justify your choice in electing him as your President.' The experience of the Leicester Conference shows that the confidence of the Union was not misplaced. Mr. Greenwood presided over the meetings with tact, urbanity, and dignity, and, on occasion, showed himself equal to any emergency. We trust that under his chairmanship the Executive will accomplish much useful work, and show that the National Union of Elementary Teachers is labouring as earnestly for the good of education as for the welfare and position of teachers.

Matriculation Hints.

By HENRY A. REATCHLOUS, M.A. (LOND.), B.Sc.,
Westminster Training College.

Latin.—We give a translation of the passages set for practice last month. The student should compare his own version with the one below. Let him try to avoid being too literal. The examiners know quite well the exact force of the expressions used by the author, and in offering for the meaning of a phrase the meanings of the separate words, the candidate does not show his knowledge, but the want of it.

(1) He is a man of distinguished courage, but I am sorry you have made him general, for his prudence is not equal to his valour, nor his wisdom to his prudence.

(2) After the storming of Carthage, Scipio circulated despatches through all the cities of Sicily, bidding them to send envoys to reclaim the ornaments of their temples which had been plundered by the Carthagenians, and have them replaced in their original positions.

The following two pieces were set in June, 1881:—

(1) Legiones duas Romanas habebat Postumius, sociorumque ab supero mari tantum conscripserat ut viginti quinque milia armatorum in agros hostium induxerit. Galli oram extremæ silvæ eum circumsedissent ubi intravit agmen saltum, tum extremas arborum succisarum impellunt. Quæ alia in aliam incidentes ancipiti strage arma viros equos obruerunt ut vix decem homines effugerent.

(2) Nostra victoria est, si quia Di vatesve eorum in futurum vident. Itaque ut decet certæ spei plenos et cum imparibus manus conserturos pilis ante pedes positis gladiis tantum dextras armemus. Ubi illi vana injicerint missilia tum micent gladii et veniat in mentem unicuique deos esse qui Romanorum adjuvent.

Those who intend matriculating very soon, will no doubt be glad to see the Greek passages set at the same examination. Translations will appear in the PRACTICAL TEACHER for June.

(*a*) *σίγησον, ὦ τάλαινα, μὴ φίλοις φόβει.*

(*b*) *πῦρ καὶ ὕδωρ καὶ γῆν καὶ ἀέρα φύσει πάντα εἶναι καὶ τύχῃ φασί, τεχνῃ δὲ οὐδὲν τούτων.*

(*c*) *ὡς τοίνυν ἐστιν ἀληθῆ τὰ μεμαρτυρημένα, οὔτ' αὐτὸν τοῦτον οὔτ' ἄλλον ὑπὲρ τούτου δεῖξαι δυνήσεσθαι νομίζω.*

(*d*) *δοκοῦσί μοι πάντες οἱ πρόσθεν εἰρηκότες τοὺς ἀνθρώπους εὐδαιμονίζειν τῶν ἀγαθῶν ὧν ὁ θεὸς αὐτοῖς αἴτιος.*

Natural Philosophy.—The student is advised to begin his study of Mechanics with the Laws of motion. It is above all things necessary that his notions of such terms as velocity, acceleration, force, energy, mass, should be clear and accurate. And a want of uniformity in exposition, and an attempt at over-simplification have done a good deal to confuse a beginner. **Velocity** is the rate of motion of a body, and when uniform, is measured by the space passed over in a unit of time; if variable, it is measured at any instant by the space that would be passed over in a unit of time if the velocity remained constant during the unit and of the same value as at the instant under consideration. The velocity will be greater as the space passed over is greater, and as the time occupied is less; hence the unit of length is involved directly, and that of time inversely; $V = \frac{\text{space}}{\text{time}} = \frac{L}{T}$. We may select as our fundamental units (since all other units are derived from them), the foot, pound, and second, or the centimetre, gramme, and second. In either case it is easy to see what change in the number expressing the velocity is involved in a change of the fundamental units. Suppose the velocity is 88 feet per second; this would plainly be $88 \times \frac{3600}{1760 \times 3} = 60$ miles per hour. **Acceleration** is rate of change of velocity. It varies, therefore, directly as the velocity acquired, and inversely as the time in acquiring it; $A = \frac{\text{velocity}}{\text{time}}$ $= \frac{L}{T} \times \frac{1}{T} = \frac{L}{T^2}$. There is a double reference to the unit of time. Hence if an acceleration be expressed by 32 when the units are a foot and a second, it would be expressed by $32 \times \frac{60 \times 60}{3} = 38{,}400$ when the units are a yard and a minute. Acceleration must never be expressed as merely so many feet per second; that would be a velocity. There must always be a second reference to time; for it makes all the difference in the world whether one foot per second is added to the velocity of a body, per second, per minute, or per hour. Acceleration, therefore, must be expressed as so many feet per second per second, or so many feet per second in a second.

It is not necessary to complete the study of the subjects dealt with in Section A before proceeding to those comprised in Section B. It will be a relief to take them together. There used to be a very general impression that the subjects treated of in the second section could be got up from books, and many persons seem to think so still. But the opinion is gaining ground that this method of learning physics is out of date; the sooner it is entirely abandoned the better. Let the student repeat the experiments for himself wherever it is possible for him to do so, and, in some instances, make as exact measurements as he can of the quantities involved. Such work has a wonderful charm and suggestiveness; it makes study more attractive as well as more real. To illustrate what we mean we will take the subject of Optics, in which the candidate has to study the laws of reflection and refraction, and the formation of images by mirrors and simple lenses. Place a candle in front of a looking-glass; notice the virtual image, erect, of the same size, and as far behind the mirror as the object is in front. Now rotate the mirror; the image will move through 90 degrees while the mirror moves through 45, *i.e.*, the image travels with twice the angular velocity of the mirror. Make diagrams on paper to represent this. Observe that the laws of reflection account for it. Move the mirror toward or away from the candle, the image will move through twice the distance. Draw a diagram for this also. Hold a glowing match before a mirror; notice the two images, the first faint, the second brighter. Prove by a diagram that the distance between the two images is twice the thickness of the glass plate. Now take two mirrors and hold them at angles of 90°, 60°, 30°; observe how the number of images increases. Then put a bright object between them and hold them parallel to each other; the number of images (theoretically infinite) will be considerable.

With curved surfaces the necessity for verification is still greater. Get a concave spherical reflector and a polished ball. The images formed by the latter are always erect, diminished, and virtual.

Now take the concave mirror: fix it on a table and place a candle between it and the wall. With a little patience it will be easy, especially if there is no light in the room except from the candle, to throw a clear image on the wall. Now measure the distance of the candle and the image from the mirror, and call the distances u and v respectively, then the radius of curvature of the mirror is $\frac{uv}{u+v}$. Make three such measurements with different values for u and v: the average of the three will be a near approximation to the truth. The measurements can be made with a common ruler or with one marked in centimetres, or the results can be converted by remembering that there are 25·4 m.m in an inch. Verify the facts that with a concave mirror the image may be (1) real, inverted, and magnified; (2) real, inverted, and diminished; (3) virtual, erect, and magnified. Observe, also, that in (1) and (2) object and image may change places. We learn from the formula $\frac{1}{v}+\frac{1}{u}=\frac{2}{r}$, that if the object be at the centre of curvature the image will be there also. Verify this. By carefully tilting the mirror an image of the candle can be thrown upon the candle itself; the image is of the same size as the object but inverted. Hence this is a second method of obtaining the radius of curvature (or the focal length, which is the half of it), and it only involves one measurement.

We now need a convex lens or two and a concave one. First take a convex lens and arrange it on the table, and focus an image of the candle on the wall. If we move the lens a little too much one way the image will have a bluish edge, and a reddish one if we move it too much the other. The right position lies between the two. Now measure the distance of the object and the image from the lens, and denoting them by u and v respectively, the focal length is $\frac{uv}{u+v}$; take these measurements in different positions, and the average will usually be very near the truth.

To find the focal length of a concave lens, place it beside a convex lens of shorter focal length, and as the combination will then act as a convex lens, the focal length of the combination can be found as before: call that F; then find the focal length of the single convex lens, call it f, then the focal length, f_1 of the concave lens can be calculated from the formula $\frac{1}{F}=\frac{1}{f}-\frac{1}{f_1}$. Diagrams illustrating what has taken place should be drawn. Of course the focal length of a concave mirror or convex lens can be got from a parallel beam of light, as from the sun; but it is useful and necessary to understand other methods as well. The convex lens can be used as a magnifier; its function being to permit us viewing an object nearer than we could do without it. If we could see an object distinctly without it at a distance of five inches, and with it at a distance of half-an-inch, it would magnify ten times; and if d be distance of distinct vision, and x the focal length of a convex lens, its magnifying power is $1+\frac{d}{x}$. There is only one formula needed for mirrors and one for lenses, if due regard is paid to the convention about signs. If an object is placed before a concave lens or before a convex lens (at a distance less than its focal length), the rays, after passing through the lens, appear to have diverged from a point near or farther from the lens than the object itself. This distance can be found from the formula $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ when we know the focal length of the lens and the distance of the object. And, further, if we know the distance we wish to place an object from the eye, and the distance we wish it to appear to be, we can find the focal length of the spectacles we must employ.

ST. ANDREWS UNIVERSITY L.L.A. EXAMINATIONS.—These examinations were held on the 14th, 15th, 16th, and 17th April, at nine different centres in Scotland, England, and Ireland. Two new centres—Birmingham and Leicester—have been added this year, and a special examination has been held at Oporto, and also in Shetland. The present centres are St. Andrews, Edinburgh, Aberdeen, London, Bristol, Halifax, Birmingham, Leicester, and Belfast. Three hundred and sixty candidates were entered for the above centres, and the subjects of examination have been Latin, Mathematics, Logic, Moral Philosophy, Natural Philosophy, English Literature, Education, Comparative Philology, History, Political Economy, French, German, Italian, Hebrew, Botany, Physiology, Zoology, Geology, and Church History. The prospectus for 1885 has just been issued, and all intending candidates who wish to obtain information with respect to subjects and regulations, may obtain copies on application to the Secretary, at the University Library, St. Andrews.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

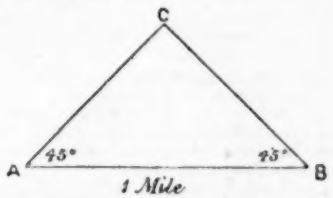
General.

1. LIA FAIL.—

SENTENCE.	KIND OF SENT.	CONNECTIVE.	SUBJECT.	PREDICATE.	OBJECT.	EXTENSION OF PRED.
(*a*) The harp now hangs as mute on Tara's walls	Princ. Sent.		The harp as mute	hangs		now (time) on Tara's walls (place)
(*b*) that once through Tara's halls the soul of music shed	Adj. Sent. to *harp* in (*a*)		that	shed	the soul of music	through Tara's halls (place) once (time)
(*c*) as [it would hang]	Adv. Sent. (manner) to (*a*) contracted	as	[it]	[would hang]		
(*d*) if that soul were fled	Adv. Sent. of condition to (*c*)	if	that soul	were fled		

Harp—com. noun, neut., sing., 3rd, nom, to 'hangs.'
that—rel. pro., neut., sing., 3rd, nom. to 'shed.'
once—adv. of time, mod. 'shed.'
through—prep., showing relation between 'halls' and 'shed.'
Tara's—prop. noun, neut., sing., poss., gov. by 'halls.'
halls—com. noun, plur., neut., obj., gov. by 'through.'
soul—com. noun, neut., sing., obj., gov. by 'shed.'
of—prep., showing rel. between 'music' and 'soul.'
music—com. noun, neut., sing., obj., gov. by 'of.'
shed—irr. trans. verb, act., ind., past, 3rd, sing., agreeing with its nom. 'that.'
now—adv. of time, modg. 'hangs.'
hangs—irreg. intrans. verb, act., ind. pres., 3rd, sing., agreeing with its nom. 'harp.'
as—adv. of deg., modg. 'mute.'
mute—adj. of qual., qual. 'harp.'
as—conj., cop., joining 'harp now hangs' and 'it would hang.'
if—conj., cop., joining 'it would hang' understood and 'that soul were fled.'
that—distg. adj., qual. 'soul.'
soul—com. noun, neut. sing., 3rd, nom. to 'were fled.'
were—irr. intrans. verb, aux. to 'fled,' indicating pass. voice.
fled—past part. of 'to flee,' referring to 'soul.'
were fled—irr. trans., pass., cond., past, 3rd, sing., agreeing with 'soul.'

2. REX.—From each of two stations, east and west of each other, the altitude of a balloon is observed to be 45°, and its bearings to be respectively N.W. and N.E.: if the stations be 1 mile apart, determine the height of the balloon. (*Lock's Elementary Trigonometry.*)



In the triangle ABC, the angles CAB, CBA are equal, therefore AC = BC (I. 6.), and angle ACB is a right angle. (I. 32.)

$\therefore AC^2 + BC^2 = AB^2$

$2AC^2 = (1 \text{ mile})^2 = (5280 \text{ ft.})^2 = 27,878,400 \text{ sq. ft.}$

$AC^2 = 13,939,200 \text{ sq. ft.}$

$\therefore AC = \sqrt{13,939,200 \text{ sq. ft.}} = \underline{3733{\cdot}5 \ldots \text{ft.}}$

∴ Distance of balloon from observers
$= \underline{3733{\cdot}5 \ldots \text{ft.}}$

3. NIL DESPERANDUM.—See answers to others. *Egan's* 'Exercises on Euclid' may be included.

4. PRECEPTOR.—The Students' (Hallam) Constitutional History of England.

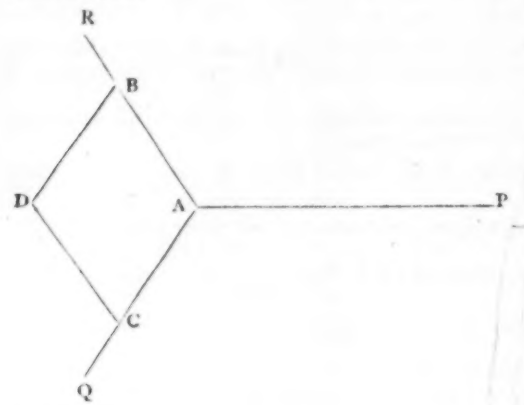
5. DUBITO.—The fact that you are 'not a P.-T.' will be of no advantage.

6. A. J. WOOD might find the Civil Service Year-Book useful.

7. CZECH.—The 'marks' assigned are not known. Your writing is too uncertain to gain more than sixty per cent.

8. Mark off along AR a part AB representing the force exerted by the man at R, and along AQ a part AC representing the force exerted by the man at Q. Through B draw a line parallel to AQ; through C draw a line parallel to AR; let D be the point of meeting of these two lines. Join AD. AD represents the resultant of the two tensions due to the men. It there-

fore represents the pressure on the tree. This pressure is transmitted along AP.



9. DOUBTFUL.—

Sentence.	Kind of Sentence.	Conn.	Subject.	Predicate.	Object.	Ext. of Pred.
(*a*) He [is listened to] more	Principal Sentence.		He	is listened [to]		more
(*b*) that no more [words] must say	Adj. to 'he' in *a*	*In rel.*	that	must say	no more [words]	
(*c*) than they [are listened to much]	Adv. sent. (manner) to *a*	than	they	[are listened to]		[much]
(*d*) whom youth and ease have taught to glose.	Adj. to 'they' in *c*.	In rel.	youth and ease	have taught	whom to glose	

He—Pers. pro., masc., sing., 3rd, nom. to 'is listened to.'
that—Rel. pron., agreeing with its ant. 'he,' masc., sing., 3rd, nom. to 'must say.'
no—Adv. of deg., mod. 'more.'
more—Adj. of number, qual. 'words' und.
must—Aux. verb to 'say,' indicating pot. mood.
say—Irr. trans. verb, act., inf., pres., gov. by 'must.'
must say—Irr. trans. verb, act., pot., pres., 3rd, sing., agreeing with its nom. 'that.'
is—Aux. verb to 'listened,' indicating passive voice.
listened—Past part. of the verb 'to listen,' refg. to 'he.'
is listened [to]—Prep.-verb, reg. trans., pass., ind., pres., 3rd, sing., agr. with its nom. 'he.' (See *note.*)
more—Adv. of quantity, mod. 'is listened to.'
than—Cop. conj., correlative to 'more,' joining the sents. 'he is listened [to]' and 'they are listened [to].'
they—Pers. pron., com., plu., 3rd, nom. to 'are listened to' und.
whom—Rel. pron., com., plu., 3rd, obj., governed by 'have taught.'
youth—Abs. noun, neut., sing., 3rd, nom. to 'has taught,' included in 'have taught.'
and—Cop. conj., joining the sents. 'youth has taught' and 'pleasure has taught.'
pleasure—Abs. noun, neut., sing., 3rd, nom. to 'has taught,' included in 'have taught.'
have—Aux. verb to 'taught,' indicating perfect tense.
taught—Past part. of 'to teach,' refg. to 'whom.'
to—Particle, indicating inf. mood.
to glose—Reg. int. verb, act., inf., pres., used as abs. noun, neut., sing., 3rd, gov. by 'have taught.'

Note.—The word *to* is understood after *is listened*, and '*to*' may be parsed either as an adverb, or, as in the text, making with *is listened* a prep.-verb.

10. BON SOIR.—(1) The solution of your query appeared in our issue for March, 1883. (2) Your writing is *pretty good*, but it is rather *too small*.

11. ANXIOUS.—Your query was solved in our issue for May, 1882.

12. QUESITA.—You will find the solution of your query in our issue for May, 1882.

13. LAKE GENEVA.—Full marks. A round hand is the best.

14. RESOLUTE HELMET.—Our space is too limited to accede to your request, but any particular question will gladly be dealt with.

15. A SUBSCRIBER can obtain the Civil Service Arithmetic, published by Crosby and Lockwood. *Mansford's* or *Fitch's* will explain the principles.

16. SUESCRIBER should write to Dr. J. C. Meredith, Sec., Royal University of Ireland, Earlsford Terrace, Dublin.

17. W. TEMPEST.—Your P. T. must fulfil his engagement according to the agreement (Schedule IV). See if he was apprenticed for the full four years.

18. FIDUS ACHATES will find his query answered in our replies 'Emperor' and 'Cicero,' page 90, last month. Both English subjects should be prepared.

19. NELLIE.—Almost any text-book; but learn the *Map* of the British Isles. Study also the National Society's Manual, 'The Science and Art of Teaching.'

20. GEOGRAPHY.—The parallels are usually arcs of concentric circles, whose common centre is outside the Map, N. or S. The meridians are equidistant on the same parallels. Get A. Gardner's 'How to draw a Map' (Hughes). Your writing is good in promise.

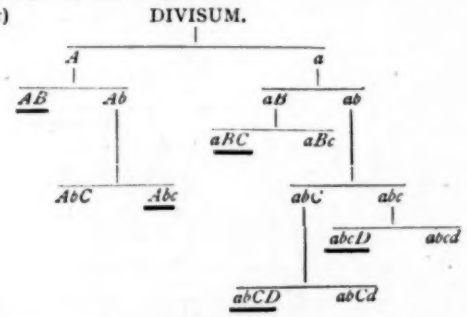
21. B.A.—What is meant by saying 'Divisio non faciat saltum'? How do you know that a 'saltus' has not been made?

Draw up a logical scheme of divisions so as to indicate the places of the following: AB, Abc, abCD, aBC, abcD; a, b, c, d, representing privative terms.

(*a*) In descending from a high genus to a species, we must avoid a sudden leap over any of the subaltern genera in the series. Each of the dividing members must come directly from the division of its own proximate genus. This is expressed by saying, Divisio ne fiat per saltum vel hiatum, or, Divisio non faciat saltum. The ordinary division of natural objects into animals, vegetables, and minerals is faulty; these are not co-ordinate: one step has been omitted. The division should be into organic and inorganic, and then the latter into vegetable and animal.

(*b*) We should know there had not been a saltus if, on making a table, such as the following, each term appeared in its proper place, none being left out.

(*c*)



Arithmetic.

1. J. ALLESTON.—Two dozen of port and 16 bottles of sherry were bought for two equal sums of money. If the quantities of the wines had been reversed, the sherry would have cost £3 more than the port. What was the price of each wine per bottle? (*Pupil Teachers' Examination.*)

16 bottles of sherry cost as much as 24 bottles of port,
∴ 1 bottle ,, ,, $\frac{24}{16}=\frac{3}{2}$,,
24 bottles ,, ,, $\frac{3}{2}\times 24=36$,,
∴ (36 − 16) bottles of port cost £3,
20 ,, ,, ,,
∴ Price of a bottle of port $=£3\div 20=3s.$;
,, ,, sherry $=3s.\times\frac{3}{2}=4s.\ 6d.$

Note.—Perhaps 90 per cent.

2. PW.—A, B, and C are partners; A receives $\frac{1}{3}$ profits; and B twice as much as C; find the capital of C, A's income being diminished £40 by a fall of $\frac{1}{2}$ per cent. in the rate of profit. (*Barnard Smith.*)

A's capital = $\frac{1}{2}$ of total capital,
C's " = $\frac{1}{2}$ of $\frac{4}{5}$ = $\frac{4}{10}$ "
Total capital = £40 × 5 × 200 = £40,000;
∴ C's capital = $\frac{4}{10}$ of £40,000 = £$\frac{40000}{3}$
= £10,666 13s. 4d. Ans.

Note.—Huxley's or *Lawson's*. See advertisement columns of back numbers.

3. BRAN.—A man can run 2½ miles in 21 minutes, and a boy can run 1½ miles in 17 minutes; find the ratio of their speeds.

Man's rate : Boy's rate :: $\frac{2\frac{1}{2}}{21} : \frac{1\frac{1}{2}}{17}$,
:: $\frac{5}{42} : \frac{3}{17}$,
:: 5 × 17 : 3 × 21,
:: 85 : 63. Ans.

4. BRUTUS.—How many 6-lb. loaves would 80 men eat in 50 days, if 40 women ate 70 5-lb. loaves in 6 days, 2 men requiring as much as 3 women? (*Scholar.*)

2 men require as much as 3 women,
∴ 80 " " 3 × 40 "
= 120 women.

women		women	
40	:	120	
lbs.		lbs.	loaves
6	:	5	:: 70 : No. required.
days		days	
6	:	50	

$$= \frac{\cancel{3} \quad 25 \quad 35}{\cancel{120} \times 5 \times \cancel{50} \times \cancel{70}} \text{ loaves}$$
$$= \frac{\cancel{2}}{\cancel{40} \times \cancel{5} \times \cancel{3}}$$
$$= \frac{875}{3} \text{ loaves} = 1458\tfrac{1}{3} \text{ loaves. Ans.}$$

5. BRUTUS.—A and B can do a piece of work in 10 hours, B and C in 12, and A and C in 15 hours; in what time could they altogether do the work, and in what time could C do it alone? (*Scholar.*)

A and B can do the work in 10 hours,
B and C " " 12 " ,
A and C " " 15 " ;
∴ A and B " in 1 hour $\frac{1}{10}$ of the work,
B and C " " $\frac{1}{12}$ " " ,
A and C " " $\frac{1}{15}$ " " ;
∴ 2 (A, B, and C) " " $\frac{1}{10} + \frac{1}{12} + \frac{1}{15}$ " "
$= \frac{6+5+4}{60}$ " "
$= \frac{15}{60}$ " "
$= \frac{1}{4}$ " "
∴ A, B, and C " " $\frac{1}{4} \div 2$ " "
$= \frac{1}{8}$ " " ;

∴ A, B, and C can do the work in 8 hours. Ans.

C can do in 1 hour $\frac{1}{8} - \frac{1}{10}$ of the work
$= \frac{5-4}{40}$ " "
$= \frac{1}{40}$ " " ;
∴ C can do the work in 40 hours. Ans.

6. JACK.—Give the exact date of 201,683 minutes reckoned forward from March 4th, at 6.50 p.m. (*Scholar.*)

201,683 minutes = 3361 hrs. 23 min.
= 140 days 1 hr. 23 min.
∴ Date = 140 days 1 hr. 23 min. from March 4th, 6.50 p.m.
= 140 days from March 4th, 8.13 p.m.;

From March 4th to March 31st = 27 days
" " 31st to April 30th = 30 "
" April 3th to May 31st = 31 "
" May 31st to June 30th = 30 "
118 days

(140 − 118) days = 22 days;
∴ Date = July 22nd, at 8.13 p.m. Ans.

7. P. T.—One vessel *m* contains a mixture of 27 gallons of wine and 11 of spirits; another vessel *n* contains a mixture of 43 gallons of wine and 14 of spirits. Compare the strengths of the two mixtures, supposing the strength of spirits to be three times that of wine.

Strength of mixture in *m* : Strength of mixture in *n*
$:: \frac{11 + \frac{11}{3}}{11 + 27} : \frac{14 + \frac{14}{3}}{14 + 43}$,
$:: \frac{11 + 9}{38} : \frac{14 + 14\frac{2}{3}}{57}$,
$:: \frac{20}{38} : \frac{28\frac{2}{3}}{57}$,
$:: \frac{10}{19} : \frac{28\frac{2}{3}}{57}$,
:: 30 : 28⅔,
:: 90 : 85,
:: 18 : 17. Ans.

8. A. W. H.—A man sells a horse, at a loss, for 40 guineas. Had he sold it for 50 guineas, his gain would have been three-fourths of his former loss. Find the cost price of the horse.

Loss + ¾ of Loss = £52 10s. − £42,
¼ of Loss = £10 10s.,
∴ Loss = £10 10s. × 4
= £42 ÷ 7
= £6.

∴ Cost price of horse = £42 + £6
= £48.

Note.—We believe your writing will obtain the full percentage of marks at both examinations.

9. M. R. S.—A contractor agrees to sink an artesian well on the following sums: £5 per fathom for the first 30 fathoms, (consisting of gravel only), £35 per fathom through the sand, £20 per fathom through the clay, etc., £25 through chalk. He found the thickness of the chalk to be equal to half the depth of the well, and that the sand beds were 3 times as thick as the clay. At the end of the work he received £2700 for his trouble. Find depth of well.

£25 × ½ No. of fathoms + £35 × ¾ (½ No. of fathoms − 30)
+ £20 × ¼ (½ No. of fathoms − 30) + £5 × 30 = £2700,
£25 × ½ No. of fathoms + £35 × ¾ No. of fathoms
− £35 × ¾ of 30 + £20 × ¼ No. of fathoms
− £20 × ¼ of 30 + £150 = £2700,
(£$\frac{25}{2}$ + £$\frac{105}{4}$ + £$\frac{20}{4}$) × No. of fathoms
− £787½ − £150 + £150 = £2700,
£$\frac{100 + 105 + 20}{8}$ × No. of fathoms = £2700 + £787½,
£$\frac{225}{8}$ × No. of fathoms = £3487½,
No. of fathoms = £3487½ ÷ £$\frac{225}{8}$
$= \frac{\cancel{6975}}{\cancel{2}} \times \frac{\cancel{8}}{\cancel{225}}$
= 124.

∴ Depth of well = 124 fathoms.

Note.—Your other query will appear next month.

10. H. BULL.—A tradesman induces customers who owe £750 to pay ready money, on a promise of 5 per cent. discount, who otherwise would not have paid for 6 months. At the end of 6 months he had received £947 12s. 6d. instead of £750; what was his gain per cent.?

£ £ £
102½ : 750 :: 100 : Present worth of debts.
2 2

$\cancel{205}$ $\cancel{1500}$
41 300

= £731$\frac{23}{41}$.
£947½ − £731$\frac{23}{41}$ = £215$\frac{109}{328}$.
£ £ £
∴ 731$\frac{23}{41}$: 100 :: 215$\frac{109}{328}$: Gain per cent.
41 328

30000 1720
8 430
645
$\cancel{240000}$ 301
800 7$\cancel{8}$$\cancel{72}$$\cancel{1}$
23607
= 29$\frac{107}{328}$ per cent. Ans.

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The numbers of the *Practical Teacher* for February and March, 1884, are now out of print.

Publications Reviewed.

Magnetism and Electricity, Part II. (Elementary Text Books.) **Botany,** Part III., and **Principles of Agriculture,** Book III. (Comprehensive School Series.) London: Blackie and Son.

In schools and places where they teach, a moot question is always upturning as to whether the best teachers should have charge of the younger or of the elder students. By many, the decision is made in favour of the juveniles. Their instruction seems to be a task at once the most difficult and the most important. Supposing that two teachers could be found exactly equal in knowledge and in ability to impart knowledge—a discovery as unlikely as that of the two identical grass-blades of our childhood search—we are not sure that the more resultful work would not follow from the labour of one of them as expended on young thinkers, than from that of the other upon 'children of a larger growth.'

Whatever doubt may exist as to this position in regard to oral teaching, none is possible, we conceive, upon the important question as to who should write our elementary text-books. The works upon science or literature or art, adopting our customary artificial distinctions, that are to guide the first steps of young minds along the pleasant paths should be written only by those who have the subject with which they deal at their fingers' ends. Unfortunately in too many cases the authors seem rather to keep their subject at arm's length. They write elementary text-books upon matters their knowledge of which is like the text-books. This is not always the case. Thus the excellent series of Science Primers issued by Messrs. Macmillan, the list of whose authors includes such names as Foster, Geikie, Hooker, Roscoe, is, as such a series should be, a set of works by masters of the several subjects. But, far too generally, the introductory books are of such a nature as to give inaccurate impressions at the most impressionable time. And to this censure the three booklets that we have received from Messrs. Blackie are open.

The best of the three is that on Magnetism and Electricity. Truly, it starts with the unfortunate phrase, 'Electricity is a force,' and places this misleading statement in the 'bad eminence' of italics. In the same first paragraph we have also such a loose expression as, 'Their name for amber, "electron" was given to this force.' Of course, electricity is a mode of motion, and its name is only derived from *elektron*. Two electricities are also mentioned, and the student is informed that by the electroscope he can 'see the presence of electricity'—an operation closely allied to 'seeing the wind.' The only other regrettable point in the little work is the explanation of thunder (p. 90), as only due to the echoing of sound from clouds and mountains. The important fact that the rolling of thunder is at least in part explicable by the ear receiving as a succession of sounds the results of concussions at various distances. The concussions are like the lightning-flash, their cause, practically instantaneous. The sounds, their consequence, reach the auditor one after the other because of the slow comparative speed at which sound travels. We think it is also matter for regret that the Holtz machine is not even mentioned. But, for the rest, the work is well done. The writer is evidently both a practical electrician and a practical teacher. The experiments are carefully chosen, carefully described, and, best of all, carefully gradated; that is, they follow one upon the other in a succession well arranged in an ascending order of difficulty, and leading the mind of the learner by steps that are never too long, or necessary to be retraced. The systematic arrangement of the whole work, and the judicious use therein of capitals, italics, letters, and numbers, mark the practical teacher.

The second and third of the books under consideration belong to the Comprehensive School Series. The one on botany is clearly written. Every one can understand what the author wants to say. Unhappily, much that he says is inaccurate, and more is unfortunate. It is unfortunate that the old word 'pistil' is still used. Gynæcium, though longer, is so much more meaningful. Pistil, as a botanical term, is exploded. The Samara fruit is denoted by its old-fashioned and not very intelligible synonym of 'key.' The misleading names, 'exogen' and 'endogen' are also retained. As an interesting transition case between the merely unfortunate and the actually inaccurate, we note the treatment of the perisperm of the seed on page 123. Not only is the old and bad name

'albumen' used, but the student is misled to believe that the reserve-material within plant-seeds is identical with the white of egg. More or less important errors are the partial blunder in the first two pages in regard to the inferior and superior ovary, the definition of a carpel as if it only consisted of the ovary region, and not also of style and stigma; the definition of the three layers of a plum-fruit (epi-meso-endo-carp) from carpel rather than καρπος (karpos)=fruit; the omission of the tegmen as a coat of the seed; and the statement that conifers are polycotyledonous. Surely a writer on botany for beginners should know that the conifers have, like the rest of the dicotyledones only two cotyledons or embryo-leaves, although each of the two divides after a time. The comments of the German school of botanists on the explanation of the apple as a fruit with a calyx-tube conjoined would also be worth hearing. But it is when our instructor of the young aspires to give information as to cryptogams that he is at his wildest and his worst in the matter of blunders. The sub-kingdom cryptogamia becomes, with him as guide, a class (p. 132). Fungi are a family. The exceedingly bad name 'acotyledons' is used. 'Ferns are the highest order or family of the flowerless plants.' Not only does this sentence make by implication an order and a family equivalent, whilst it treats of a group *filices*, which is neither an order nor a family, but it contains a most inaccurate statement. Two classes at least, the club-mosses and the rhizocarps, are higher cryptogams than the ferns. With the other end of the sub-kingdom the author is equally at fault. 'Lichens are the lowest form of vegetable life.' Not a word is said as to Schwendener's demonstration that lichens are not a class *per se*, and are only fungi, parasitic on algæ. And even passing over this, lichens are by no means the 'lowest form of vegetable life.' Torula and protococcus, with their allies, are in evidence against this idea. How little the author is qualified to deal with his subject may be gathered from two contradictory passages within half-a-dozen pages one of the other:—'The flowerless plants are entirely destitute of stamens and pistil, or of any organs which might correspond to them. . . . . The cells are not all alike. They are of two kinds, one sort being round, the other long or spindle-shaped. They are the actual flowers of this microscopic plant, or, at all events, they do the work which flowers accomplish in the flowering plants. The long, spindle-shaped cells represent the females, and the rounded cells the male or staminate flowers. From the striking resemblance existing between these round cells and the anthers of flowers they have been called *antheridia*. The long spindle-shaped cells are like the ovary of the pistillate flower, for they contain a sort of germ.' The only words of unqualified praise that we can give are for the good diagrams, the practical method adopted in the teaching, and especially for a very clear account of the difference between a monocotyledonous and a dicotyledonous seed (p. 118).

Elementary Text-Book of Physics. By. J. D. Everett. London: Blackie and Sons.

With what a sense of relief we turn from the three little books of which we are bound to speak thus strongly, to another issued by the same publishers. The copy forwarded us is one of the second edition. The first edition has been the delight of physical teachers and students for the last two or three years. The volume, of 316 pages, is the very model of a text-book in elementary science. The clearness of its print and the excellence of its diagrams are the least important points, notable as they are in themselves. The clearness of thought and the excellence of method far out-weigh these companion virtues. Here is a writer completely master of his subject. His mastery of all the intricacies and all the generalisations of every branch of Physics fits him for dealing with the rudiments of the subject. It seems almost an impertinence to say, that there is not a blunder from one end of the book to the other. Not only are all facts and principles given with scrupulous accuracy; they are given also in the clearest language. More than that. Only those who have had some practical experience of teaching will fully understand the remarkable skill with which Professor Everett has taken exactly the right facts and principles out of the many from which he had to choose. It is the rarest skill, this—to select from the vast storehouse of truths mechanical, thermal, electrical, precisely those that are the best, the most essential for the beginner, as giving a firm foundation for his scientific feet. It is a skill that may grow. For the difference between the first and second editions of Professor Everett's book is the outcome of an advance in the author's power of teaching. He has advantageously omitted certain paragraphs of over difficulty, and especially all that has to do with 'absolute units.' In this he has shown a wisdom that is not, we think, exactly paralleled in the greater extent to which British units have been employed. If the teachers of science themselves give way in the contest between the sensible metric system and the senseless English measures, the victory of the rational system will be long delayed. The same blunder as that made by Professor Everett is committed by the examiners of the Science and Art Department in Theoretical Mechanics. All the questions given by them in the elementary stage are most unfortunately in terms of pounds, feet, pints, and so forth. When once, with due and timely notice, the Department brings about a change in this matter, and Science and Art students know that they must learn the metric system in place of our barbarous 'tables,' and when such writers as Professor Everett refuse to have any pandering with the evil set of English measurements, the day for the consistent use of the decimal system in all scientific calculations will be at hand. That day will be the precursor, probably, of the introduction of the same simple system into ordinary usage in ordinary life. Quitting this point, on which we are, to some extent, at issue with our author, we may end by saying, that of all the elementary treatises we have seen on Physics, not even excepting the excellent work of Balfour Stewart, this is by far the best. It is at once the most complete and the most thorough. It is really a beautiful book.

Elementary Lessons in the Principles of Agriculture. By W. J. Harrison, F.G.S. Second Stage. London: T. Nelson and Sons.

Some months ago we favourably reviewed the corresponding part of this work for the first stage, and we are glad to see that the second is equally creditable to both author and publishers. The book is clearly printed and well illustrated. Its matter is well arranged and most readable. It forms a capital elementary, and yet practical, introduction to the science of agriculture.

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Letter-Note School Music. By D. Colville. J. Adley and Co., Cornwall Road. London: F. Pitman.

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—o—

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Smith (Walter)—
The Student's Proper Psalms. With Notes. By the Rev. G. W. Wall, M.A.

Smith, Elder, and Co.—
The Cornhill Magazine, No. 10, for April.

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The Universal Instructor. Part XLII.—April.

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